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Region 2 RAC2
Remedial Action Contract

Final Human Health Risk Assessment

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Remedial Investigation/Feasibility Study

Garden City, Nassau County, New York

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537623

CDM Smith

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Acronyms

bgs	below ground surface
Cal/EPA	California Environmental Protection Agency
CDM Smith	CDM Federal Programs Corporation
CNS	central nervous system
COPC	chemical of potential concern
CSM	conceptual site model
CTE	central tendency exposure
EPA	U. S. Environmental Protection Agency
EPC	exposure point concentration
FS	Feasibility Study
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
IRIS	Integrated Risk Information System
IUR	inhalation unit risk
NOAEL	no-observed-adverse-effect level
NYSDEC	New York State Department of Environmental Conservation
OSWER	Office of Solid Waste and Emergency Response
OU	Operable Unit
Pasley	Pasley Solvents and Chemical
PCE	tetrachloroethene
PPRTV	Provisional Peer Reviewed Toxicity Values
Purex	Purex Mitchell Field Area
QC	quality control
RA	remedial action
RAGS	Risk Assessment Guidance for Superfund
RfC	reference concentration
RfD	reference dose
RI	Remedial Investigation
RME	reasonable maximum exposure
ROD	Record of Decision
RSL	Regional Screening Level
SF	slope factor
the site	Old Roosevelt Field Contaminated Groundwater Area Site
TCE	trichloroethene
UCL	upper confidence limit
U.S.	United States
VC	vinyl chloride
VOC	volatile organic compound
WA	Work Assignment
mg/kg-day	milligram per kilogram per day
mg/m^3	milligram per cubic meter

µg/L	microgram per liter

Executive Summary

CDM Federal Programs Corporation (CDM Smith) received Work Assignment (WA) 047-RICO-02PE for the Old Roosevelt Field Contaminated Groundwater Area Site (the site), Operable Unit (OU)2, under the Response Action Contract, Contract No. EP-W-09-002 for the United States Environmental Protection Agency (EPA), Region 2. The objective of this WA is to perform a remedial investigation/feasibility study (RI/FS) and a human health risk assessment (HHRA) for OU2.

This HHRA, as part of the RI/FS, is developed to characterize the potential human health risks associated with the groundwater at the site in the absence of any remedial action. The HHRA is conducted in accordance with current EPA guidance outlined in *Risk Assessment Guidance for Superfund* (RAGS), Parts A, D, and E and other EPA guidance pertinent to human health risk assessments.

Site Background and Setting

The Old Roosevelt Field Contaminated Groundwater Area Site includes an area of groundwater contamination in the Village of Garden City, in central Nassau County, New York. The area of groundwater contamination is associated with the former Roosevelt Field airfield, which includes an area east of Clinton Road and south of Old Country Road and extends beyond Meadowbrook Parkway to the east. OU1 addressed groundwater contamination predominantly in the western portion of the site. OU2 is addressing the contaminated groundwater in the eastern portion of the site. The former Roosevelt Field airfield area is currently developed as a large retail shopping mall with several restaurants and a movie theater, office building complexes, and other smaller shopping centers. Office building complexes (including Garden City Plaza) are situated on the western perimeter of the shopping mall, and Meadowbrook Parkway is located on the eastern perimeter of the shopping mall. A thin strip of open space along Clinton Road (known as Hazelhurst Park) serves as designated parkland and a buffer between a residential community and the mall complex. Two retention basins are directly east and south of the mall complex. Two municipal supply well fields are located south (downgradient) of the former Roosevelt Field airfield hangars. The Village of Garden City public supply wells (designated as Wells 10 and 11) are located just south of the former hangar area along Clinton Road. The Village of Hempstead supply wells are located approximately 1 mile south of the Village of Garden City Wells 10 and 11. The former Avis (Avis) Headquarters property, located at 900 Old Country Road, is in the northeastern portion of the former Roosevelt Field airfield (south of Old Country Road and west of Zeckendorf Boulevard). Avis leased the property from 1980 until 2001. Prior to that period, the property was used for various defense- and civilian-related manufacturing. Previous investigations conducted at this property under New York State Department of Environmental Conservation (NYSDEC) oversight revealed the presence of soil and groundwater contamination. As a result, this property was addressed under NYSDEC's Brownfield program.

Data Evaluation

The RI activities were conducted to characterize the nature and extent of groundwater contamination at the site. Data usability assessments of all analytical data were performed and

determined that all data met project requirements for representativeness, completeness, precision, and accuracy, and all data are suitable for use in this HHRA.

Chemicals of potential concern (COPCs) are identified based on criteria outlined in EPA risk assessment guidance, primarily through comparison of maximum detected concentrations to risk-based screening levels. Eleven volatile organic compounds and five inorganics are identified as COPCs in groundwater.

Exposure Assessment

Potential exposure pathways are defined based on potential source areas, release mechanisms, and current and potential future uses of the site. Since pumped water from the Village of Garden City wells is treated before reaching potential receptors, only potential future residents and site workers are evaluated in the risk assessment. Exposure pathways evaluated for groundwater include ingestion of, and dermal contact with, groundwater and inhalation of vapor released during showering and bathing and inhalation of vapor through vapor intrusion.

Exposure point concentrations (EPCs) for the COPCs are used in the exposure assessment calculations to estimate potential chemical intake. The EPC is the lower of the upper confidence limit on the mean or the maximum detected concentration.

Quantification of exposure includes evaluation of exposure parameters that describe the exposed population (e.g., contact rate, exposure frequency and duration, and body weight). Each exposure parameter in the equation has a range of values. Daily intakes are calculated based on the reasonable maximum exposure (RME) scenario (an upper bound exposure reasonably expected to occur). The intent is to estimate a conservative exposure case that is still within the range of possible exposures. Central tendency exposure (CTE) assumptions are also developed when the estimated risks under the RME scenario exceed EPA's threshold risk range. CTE scenarios reflect more typical exposures.

Toxicity Assessment

COPCs are quantitatively evaluated based on their noncancer and/or cancer potential. The reference dose (RfD) and reference concentration (RfC) are the toxicity values used to evaluate noncancer health hazards in humans. Inhalation unit risk and slope factor are the toxicity values used to evaluate cancer health effects in humans. These toxicity values are obtained from various sources following the hierarchy order specified by EPA.

Risk Characterization

Risk characterization integrates the exposure and toxicity assessments into quantitative expressions of risks/health effects. To characterize potential noncancer health effects, comparisons are made between estimated intakes of substances and toxicity thresholds. Potential cancer effects are evaluated by calculating probabilities that an individual will develop cancer over a lifetime exposure based on projected intakes and chemical specific dose-response information. In general, EPA recommends an acceptable cancer risk range of 1×10^{-6} (1 in 1 million) to 1×10^{-4} (1 in 10,000) and noncancer health hazard index (HI) of unity (1) as threshold

values for potential human health impacts. These values aid in determining whether additional remedial action is necessary at the site.

Potential risks/hazards were identified for future residents and site workers in the unlikely event that a private well is installed on the site. Cancer risks for future residents exceed EPA's acceptable cancer risk range mainly due to vinyl chloride (VC) and trichloroethene (TCE) in groundwater. The estimated cancer risks may be overestimated because VC was only detected in 1 out of 13 data points. The estimated cancer risk for site workers under the RME scenario is above EPA's acceptable cancer risk range but within EPA's acceptable cancer risk range under the CTE scenario. For noncancer hazards, the total HIs for future residents are above EPA's threshold of unity at the site under both the RME and CTE scenarios and are driven primarily by potential exposure to TCE and tetrachloroethene (PCE) in groundwater.

Lead was evaluated separately and does not appear to be a concern for all receptors because the maximum detected concentration was below the screening level. Results of the vapor intrusion evaluation indicated that future site workers and residents potentially might be exposed to elevated concentrations of several volatile COPCs, including TCE and PCE, via inhalation of vapor emanating from groundwater into enclosed structures via vapor intrusion. However, no indoor air samples were above levels of concern in any of the structures sampled as part of the OU1 vapor intrusion evaluation. Thus, EPA does not expect to perform any further vapor intrusion sampling at the site.

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Section 1
Introduction

CDM Federal Programs Corporation (CDM Smith) received Work Assignment (WA) 047-RICO-02PE for the Old Roosevelt Field Contaminated Groundwater Area Site (the site), Operable Unit (OU)2, under the Response Action Contract, Contract No. EP-W-09-002 for the United States Environmental Protection Agency (EPA), Region 2. The objective of this WA is to perform a remedial investigation/feasibility study (RI/FS) and a human health risk assessment (HHRA) for the site.

This HHRA, as part of the RI/FS, is developed to characterize the potential human health risks associated with the groundwater at the site in the absence of any remedial action. This HHRA identifies the potential exposure pathways by which populations may be exposed. Exposure pathways are identified based on considerations of the sources and locations of contaminants related to the site, the likely environmental fate of the contaminants, and the location and activities of the potentially exposed populations. The HHRA describes exposure points and routes of exposure for each exposure pathway as well as underlying assumptions regarding receptor characteristics and behavior (e.g., body weight, ingestion rate, and exposure frequency). The HHRA also identifies chemicals of potential concern (COPCs) for the environmental medium of concern, exposure point concentrations (EPCs), and toxicity values of COPCs. Finally, the HHRA characterizes potential cancer risks and noncancer health hazards associated with each complete exposure pathway.

1.1 Overview

This HHRA is developed in accordance with EPA guidance documents. In addition, CDM Smith reviewed available information pertaining to the site to prepare this HHRA. Potential exposure pathways, exposure routes, and potentially exposed populations under current and future land-use scenarios are identified. Exposure parameters and daily intakes for exposure scenarios are quantified, and toxicity values for COPCs are presented. The exposure pathways and receptors, exposure parameters, daily intakes, and toxicity values are presented in tabular form in accordance with the standard tables in *Risk Assessment Guidance for Superfund (RAGS) Part D* (EPA 2001) and the Office of Solid Waste and Emergency Response (OSWER) Directive 9200.1-120 (EPA 2014a).

1.2 Report Organization

This HHRA is comprised of eight sections, with tables and figures presented at the end of the text. The organization of the report and the contents of each section are described below.

Section 1 — Introduction – provides an overview of the objectives and organization of this report.

Section 2 — Site Background and Setting – describes the site location and description, site history, site geology and hydrogeology, and demography and land use.

Section 3 Data Evaluation – presents sample collection and analysis of groundwater, analytical data summary, data usability, and identification of COPCs.

Section 4 Exposure Assessment – presents the conceptual site model (CSM) and identifies potential exposure pathways and potential receptor populations under both current and future land-use scenarios. In addition, methods for calculating EPCs and exposure parameter assumptions are presented.

Section 5 Toxicity Assessment – discusses the relevant toxicity information of identified COPCs.

Section 6 Risk Characterization – integrates the toxicity and exposure assessments into quantitative and qualitative expressions of risk and discusses uncertainties associated with the risk estimates.

Section 7 Summary and Conclusions – summarizes the results of the risk assessment and presents conclusions based on the results.

Section 8 References – lists references cited in this report.

Section 2
Site Background and Setting

This section discusses the site location and description, site history, site geology and hydrogeology, and demography and land use. This information is used to develop site-specific information on exposure pathways and receptors associated with the site.

2.1 Site Location and Description

The site includes an area of groundwater contamination in the Village of Garden City, in central Nassau County, New York. The area of groundwater contamination is associated with the former Roosevelt Field airfield, which includes an area east of Clinton Road, south of Old Country Road, and extends beyond the Meadowbrook Parkway to the east. (Figure 2-1).

OU1 addressed groundwater contamination predominantly in the western portion of the site. OU2 is addressing groundwater contamination in the eastern portion of the site (Figure 2-2). The former Roosevelt Field airfield area currently includes a large retail shopping mall and other smaller shopping centers. Office building complexes (including Garden City Plaza) are situated on the western perimeter of the shopping mall, and Meadowbrook Parkway is located on the eastern perimeter of the shopping mall. A thin strip of open space along Clinton Road (known as Hazelhurst Park) serves as designated parkland and a buffer between a residential community and the mall complex. Two retention basins are directly east and south of the mall complex. Two municipal supply well fields are located south (downgradient) of the former Roosevelt Field airfield hangars. The Village of Garden City public supply wells (designated as Wells 10 and 11) are located just south of the former hangar area along Clinton Road. The Village of Hempstead supply wells are located approximately 1 mile south of the Village of Garden City Wells 10 and 11. The former Avis (Avis) Headquarters property, located at 900 Old Country Road, is in the northeastern portion of the former Roosevelt Field airfield (south of Old Country Road and west of Zeckendorf Boulevard). Avis leased the property from 1980 until 2001. Prior to that period, the property was used for various defense- and civilian-related manufacturing. Previous investigations conducted at this property under New York State Department of Environmental Conservation (NYSDEC) oversight revealed the presence of soil and groundwater contamination. As a result, this property was addressed under NYSDEC's Brownfield program.

2.2 Site History

The site was used for aviation activities from 1911 to 1951. The original airfield encompassed roughly 1,000 acres east of Clinton Road and south of Old Country Road. The United States (U.S.) military began using the field prior to World War I. After World War I, the U. S. Air Service authorized aviation-related companies to operate from Roosevelt Field but maintained control until July 1, 1920 at which time the government relinquished control of the field. The property owners later sold portions along the southern edge of the field and split the remainder of the property into two flying fields. The eastern half, with sod runways and only two hangars, continued as Roosevelt Field. The western half, which had many hangars, flying schools, and

aviation maintenance shops, became known as Curtiss Field. Roosevelt Field, Inc. purchased both fields in 1929, and the entire property was once again called Roosevelt Field.

Roosevelt Field was used by the Army and Navy during World War II. In July 1939, Roosevelt Field, Inc. began providing training in airplane and engine mechanics to Army personnel at its school. After the U.S. entered the war, civilian flying and private hangar rental ceased at Roosevelt Field due to a ban on private flying in defense areas. In addition to the training activities, the Roosevelt Field facilities were used to receive, refuel, crate, and ship Army aircraft.

In November 1942, the Navy Bureau of Aeronautics established a modification center at Roosevelt Field to install British equipment in U.S. aircraft for the United Kingdom. By 1943, the Navy had built wooden buildings between four of the hangars and leased six additional hangars. The Navy vacated the field after the end of the war. Restoration of buildings and grounds was completed in 1946, and Roosevelt Field operated as a commercial airport until it closed in May 1951.

In 1957, the Roosevelt Field shopping center was constructed at the site. The old field is currently the site of the shopping mall and office building complexes and is surrounded by commercial areas and light industry. The last of the old Navy hangars were removed in 1971.

It is likely that chlorinated solvents were used at Roosevelt Field during and after World War II. Chlorinated solvents such as tetrachloroethene (PCE) and trichloroethene (TCE) have been widely used for aircraft manufacturing, maintenance, and repair operations since approximately the 1940s. By May 1938, the Bureau of Aeronautics had published a specification covering TCE and had approved at least one company to supply TCE. The finish specifications for at least one type of plane that the Navy modified at Roosevelt Field called for aluminum alloy to be cleaned with TCE, and TCE was specified as a degreasing agent.

The Village of Garden City installed supply wells GWP-10 and GWP-11 in 1952 and placed them into service in 1953. In the late 1970s and early 1980s, investigations conducted by Nassau County discovered PCE and TCE contamination in Wells 10 and 11; concentrations increased significantly until 1987, when an air-stripping treatment system was installed to treat the water from the supply wells. Sampling results of treated well water from May 1993, September 1995, and June/July 1999 indicated that breakthrough of the treatment system had occurred, and as a result, modifications to the air-stripping treatment system were made to improve its operation. The highest levels of volatile organic compound (VOC) contamination were noted in untreated groundwater during the mid-to late 1990s. VOC levels have steadily declined since that time although the levels remain above EPA and New York State drinking water standards.

In addition to the Village of Garden City supply wells, seven cooling water wells pumped groundwater from the Magothy aquifer for use in building air conditioning systems in the mall area. These wells pumped variable amounts of water, with greater extraction rates during hot summer months. The wells operated from approximately 1960 to 1985. After extracted groundwater was used in air conditioning systems, the untreated water was returned to the aquifer system by surface recharge in the Pembrook recharge basin or, after minimal treatment, to a drain field west of Garden City Plaza Buildings 100 and 200.

Discharge of contaminated water to the recharge basin and drain field continued until the mid-1980s when the wells were taken out of service. Surface discharge of contaminated groundwater spread contamination through the Upper Glacial and Magothy aquifers. Localized groundwater mounding may have spread contamination at the water table. However, the sandy nature of the recharge basin soils likely did not result in retention of VOCs in the unsaturated zone. In addition, the zone below the recharge basin has been flushed with stormwater runoff for 20 years, so residual contamination from Roosevelt Field is not likely to remain. The Pembrook recharge basin currently only receives surface stormwater runoff from parking lots surrounding the mall and office buildings. The drain field/diffusion wells near Building 100 are under the paved parking lot west of Buildings 100 and 200, and are not currently identifiable in the field. Significant groundwater contamination is present at depth at multi-port monitoring well SVP-4 (installed as part of the OU1 RI), which is located near the general area of the diffusion wells/drain field.

The site was listed on the National Priorities List on May 11, 2000. EPA completed an RI/feasibility study (FS) in 2007. Based on the findings in the OU1 RI and the recommendations in the FS, EPA selected a remedy which was documented in a Record of Decision (ROD) in September 2007. In accordance with the ROD, a remedial action (RA) was completed in 2011, consisting of a groundwater extraction and treatment system. Currently, a remedy is in operation and includes groundwater extraction from three wells (EW-1S, EW-1I, and EW-1D), and onsite treatment using an air stripper and discharge to recharge basin #124.

During the RA, additional monitoring wells were installed at the Roosevelt Field Mall property, in the eastern portion of the site, to monitor the performance of the groundwater treatment system. Groundwater data collected in 2011 from the additional monitoring wells indicated contamination in the eastern portion of the mall area. This portion of the site was not addressed in the 2007 ROD. Based on these developments, EPA divided the site into two OUs: OU1 and OU2. OU1 addressed the identification and abatement of the groundwater contamination associated with the western portion of the site. OU2 addresses the identification and abatement of the groundwater contamination in the eastern portion of the site.

2.3 Site Geology and Hydrogeology

This section provides a summary of the geology and hydrogeology characteristic of the site. A detailed description of site geology and hydrogeology can be found in the RI report.

The upper glacial deposits are approximately 80 to 100 feet thick and fairly uniform in grain size distribution and lithology at the site. The presence of a local aquitard separates the overlying upper glacial deposits from the underlying Magothy Formation. The aquitard thickness ranges from 10 to 33 feet but was typically 10 to 20 feet thick. This aquitard is potentially present in upgradient borings. Locally, the top of the Magothy Formation was observed in the average depth range of 80 to 100 feet below ground surface (bgs) in most of the site area. In the upgradient portion of the site, the Magothy is approximately 525 feet thick. The Magothy Formation is primarily a fine to medium quartz sand, characterized by vertically alternating layers of sand, clayey sand, sandy clay, lignite, and some gravel in the basal section. Gravel-rich zones were encountered at the boreholes located south of the mall.

The water table ranges from approximately 17 feet bgs (SVP-6-5) to 35 feet bgs (MW-2S) in the area as measured during the December 2016 synoptic water level measurements. Groundwater flow is generally to the south/southwest in the shallow, intermediate, and deep zones. The horizontal gradient is similar in each of the three depth zones, with an increase in gradient with depth. Shallow groundwater flow is locally influenced by pumping at the Purex site in the eastern portion of the OU2 study area. Based on water level elevations in clustered and multi-port wells, vertical groundwater flow is downward.

2.4 Demography and Land Use

The site is in a densely developed portion of Nassau County—a mixed commercial-residential area. Current land use for the area surrounding the site is mixed commercial and residential. The site is in East Garden City (area = 3.0 square miles) within the Town of Hempstead. East Garden City supports 979 residents, 275 households, and 243 families. Of the 275 households, 47.6 percent have children under the age of 18 living with them. The Village of Garden City (area = 5.3 square miles) lies south and west of the site. Garden City supports approximately 21,672 residents, 7,386 households, and 5,857 families. Of the 7,386 households, 36.1 percent have children under the age of 18 living with them. Roosevelt Field Mall is the largest in New York State and the 11th largest in the U.S., with an area of 2,146,000 square feet. The mall provides employment for several thousand people and receives millions of visitors each year (US Census Bureau 2010).

The former Roosevelt Field airfield includes commercial office development to the west, a large regional shopping mall complex on the east (Roosevelt Field Shopping Center), smaller shopping centers along Old Country Road, an area occupied by undeveloped woodland, recharge basins, Stewart Avenue School immediately south of the office park, and mixed retail-commercial businesses immediately south of the shopping mall. Immediately beyond Stewart Avenue is an area of retail strip development, commercial, and light industrial development. This area includes two sites, the Pasley Solvents and Chemical (Pasley) site (a deleted NPL site) and the Purex site (a state hazardous waste site). Other industrial sites in the area also have been investigated with oversight by NYSDEC, including the Former Avis Headquarters site and the Johnson and Hoffman site. Farther south and south-southwest, land use is predominantly single-family residential. Homes in this area of Garden City and Hempstead use the municipal water supply pumped from local village well fields for potable drinking water and the municipal sewer system for sanitary wastewater disposal.

Section 3
Data Evaluation

Groundwater samples were collected to characterize the nature and extent of contamination at the site. The data evaluation step consists of reviewing and evaluating available data, which allows for the identification of COPCs. The following subsections describe sample collection and analysis, data usability and the suitability of data for risk assessment purposes, analytical data summary, and the approach used to identify COPCs.

3.1 Sample Collection and Analysis

The OU2 groundwater investigation was conducted in December 2016. CDM Smith collected one round of groundwater samples from 16 monitoring wells, 2 tap water samples from public supply wells (N-08474 and N-08475), and 16 samples from 5 multi-port wells. Groundwater samples were submitted to Chemtech Consulting Group through EPA's Contract Laboratory Program for VOCs analysis, and four samples were submitted to EPA's Division of Environmental Science and Assessment laboratory for analysis of metals and monitored natural attenuation parameters. Nassau County sampled 13 monitoring wells 3 of which are near the OU2 groundwater investigation (i.e., GWX-10020, N-9961, and N-9967). The two tap water samples and samples from upgradient multi-port well (SVP-1) are not included in this HHRA. All monitoring well sample locations are shown on Figure 3-1. Samples collected and evaluated in this HHRA are listed in Table A-1 (Appendix A).

3.2 Data Usability

All analytical data were reviewed to ensure that project requirements for representativeness, completeness, precision, and accuracy were met. A data usability report, which presents the validation items reviewed, problems encountered, and the achievement of the data quality objectives, was prepared for all samples collected. Data that did not meet quality control (QC) criteria were appropriately qualified during data validation as an estimated detection "J", "J+" or "J-", not detected "U", or not detected and estimated "UJ". All data qualified as estimated is usable. The final percentage of valid data for the groundwater samples is 100 percent. The ninety percent completeness goal for usable data has been met.

3.3 Summary of Analytical Results

The evaluation and summary of analytical results are based on those chemicals that were reported at concentrations higher than the reporting limit in one or more samples. The HHRA uses existing monitoring well data to identify potential risks associated with impacted groundwater in accordance with *Determining Groundwater Exposure Point Concentrations, Supplemental Guidance* (EPA 2014b). Residential well data are not being considered for use in the HHRA. For each monitoring well location, maximum concentrations from samples collected at multiple depths in a multi-port well or maximum concentrations from paired monitoring wells were used. As a result, a dataset of 13 data points for VOCs and a dataset of 2 data points for inorganics were used in the HHRA. Statistical summaries, comprising the minimum and

maximum detected concentrations and detection frequency for all chemicals, are presented in Table B-2 in Appendix B.

Twenty-three VOCs and 16 inorganics were detected in groundwater. PCE and TCE are the most frequently detected VOCs. TCE was detected in 10 of 13 data points, with a maximum detected concentration of 150 microgram per liter (µg/L). PCE was detected in 9 of 13 data points, with a maximum detected concentration of 600 µg/L. Vinyl chloride (VC) was only detected in 1 of 13 data points at an estimated concentration of 9.1 µg/L.

3.4 Identification of Chemicals of Potential Concern

Screening of analytical data is conducted to identify COPCs to be further evaluated in the risk assessment. Screening helps to focus the assessment on chemicals that could pose a human health risk.

Maximum detected concentrations are compared to screening levels to identify COPCs. The risk-based screening levels used in this risk assessment are tap water *Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites* (EPA 2016). To account for exposure to multiple chemicals, RSLs for chemicals based on noncancer health effects are decreased by a factor of 10 to account for a target hazard quotient (HQ) of 0.1.

Chemicals are considered COPCs if the maximum detected concentration exceeds the respective screening level. Group A carcinogens (i.e., known human carcinogens) are retained as COPCs even when they are present at the site at concentrations below their respective screening levels. Chemicals that are essential nutrients (magnesium, calcium, potassium, and sodium) are not evaluated as COPCs. Since the data set consisted of less than 20 data points, detection frequency was not considered in eliminating COPCs. The decision process for identifying COPCs is provided in Table B-2 in Appendix B. COPCs identified in groundwater for further quantitative evaluation in the HHRA are presented in Table 3-1.

Risks from exposure to lead are not quantified following the exposure models for other COPCs. EPA considers lead to be a special case due to lack of toxicity values for lead. Health risks from lead are evaluated based on blood lead concentration, which can be modeled using the Integrated Exposure Uptake Biokinetic Model for residential exposure scenarios. For groundwater, the screening level of 15 µg/L is based on the Federal Action Level. The screening process for lead is performed separately in the Lead Worksheet detailed in Table 3-2. As shown in Table 3-2, the maximum concentration of lead in groundwater at the site (3.9 µg/L) is below the screening level. Therefore, lead is not identified as a COPC for the site.

Section 4
Exposure Assessment

As a component of the HHRA, the exposure assessment strives to predict human exposure to COPCs in contaminated media at the site and in the vicinity. The exposure assessment describes exposure scenarios in which people may come into contact with COPCs and provides equations and parameters to quantify exposure. Results of the exposure assessment are integrated with chemical-specific toxicity information to characterize potential risks.

4.1 Exposure Pathways

Potential exposure pathways for the site are defined based on current and potential future land uses. Each potential pathway is evaluated considering site-specific conditions to determine if the pathway could be present. The area demography and land use characteristics are taken into consideration when the pathways are developed. If a pathway between the source of contamination and a human receptor potentially could be complete, it is retained for further evaluation.

4.1.1 Conceptual Site Model

Sources of contamination at the site include the former airfield, at which solvents such as TCE and PCE were used for cleaning, degreasing, and de-icing, and potentially another source upgradient of the site that is contributing contamination to the intermediate zone. At the time, the common disposal method for used and/or spent solvents was direct discharge to the ground surface. It is presumed that ground disposal of solvents at the former airfield most likely occurred close to hangars where aircraft maintenance was performed; however, numerous discharge areas may have been used while the airfield was active.

Liquid chlorinated solvents (e.g., TCE and PCE) discharged directly to the ground surface would be expected to migrate downward through the unsaturated zone in a relatively linear pattern, with minimal dispersion from the discharge location. At the site, groundwater generally flows toward the south. However, the natural movement of groundwater and TCE/PCE in the saturated zone has been complicated by the extensive groundwater extraction that has occurred in the area from several types of wells. Other potential sources of PCE and TCE in the eastern area of the site include facilities north of Old Country Road and northeast of the Meadowbrook Parkway; however, these areas were not investigated during the OU2 RI.

4.1.2 Identification of Exposure Pathways

As defined in the RAGS Part A (EPA 1989), an exposure pathway is composed of the following elements:

- A source and mechanism of chemical release to the environment
- An environmental transport medium (e.g., groundwater) for the released chemical and/or mechanism to transfer the chemical from one medium to another

- A point of potential contact by humans with the contaminated medium
- A route of exposure (i.e., ingestion, inhalation, or dermal contact)

In the risk assessment, pathways are identified for the No Action alternative to evaluate risk if no site remediation occurs. This assessment assumes that no additional restrictions to site access or use exist. The goal of this evaluation is to establish whether it is feasible for individuals to engage in activities resulting in exposure to contaminants.

Previous sampling and current RI sampling has documented groundwater contamination. Pumped water from the Village of Garden City wells is treated before reaching potential receptors; therefore, no complete exposure pathways currently exist. Nassau County does not permit installation of private wells for areas supplied by public water (Article 4, Public Health Ordinance). However, if the municipalities removed the treatment systems or if those systems failed, the most likely future receptors for site-related contamination are users of municipal water drawn from the contaminated zone of the aquifer. Residents could be exposed to contaminated groundwater via ingestion of groundwater, dermal contact with groundwater, and inhalation of chemical vapors while showering/bathing. In the unlikely event that a private well is installed at the site in the future, or if the municipalities removed the treatment systems or if those systems failed, workers may have direct exposure to groundwater via ingestion. Future residents and site workers potentially may be exposed to volatile COPCs via inhalation of vapor emanating from groundwater into enclosed structures via vapor intrusion. A screening for the evaluation of the vapor intrusion pathway is presented in Appendix E.

4.2 Characterization of Potentially Exposed Populations

The Magothy and Upper Glacial aquifers are the most productive and heavily utilized aquifers on Long Island and are important sources of drinking water in Nassau County. Pumped water from the Village of Garden City wells is treated before reaching potential receptors. Because private wells are not permitted in the area, there is no exposure risk from unmonitored water supplies. The former airfield is currently the site of a large shopping mall/office complex and is surrounded by residential and commercial areas and light industry. Based on this land use, the populations that could be exposed to site-related contamination (i.e., the potential receptors) include residents and site workers. The following subsection details the potential receptors that may be exposed to site contaminants via complete exposure pathways identified in Section 4.1. A summary of the potential exposed receptors and exposure pathways is illustrated in Figure 4-1 and presented in Table 4-1.

4.2.1 Current Receptors

Potential current receptors are identified to be residents and site workers. However, pumped water from the Village of Garden City wells is treated before reaching potential receptors. Therefore, current receptors are not assessed further.

4.2.2 Future Receptors

4.2.2.1 Residents

Future residents are evaluated as receptors even though development of the shopping mall and office complex as a residential area is highly unlikely. In the unlikely event that a private well is

installed on the site that draws from the contaminated portion of the aquifer or if the municipality were to remove the treatment systems from the public supply system or if those systems failed, potential future onsite and nearby residents may come into contact with contaminants in onsite groundwater through ingestion, dermal contact, and inhalation of VOCs in groundwater.

Thus, for conservative purpose, future residents (adults and children [birth to <6 years old]) are evaluated as potential receptors using default exposure parameters recommended by EPA as described in Section 4.4.

4.2.2.2 Site Workers

Future workers may be exposed to groundwater via ingestion in the unlikely event that a private well is installed on the site or if the municipalities removed the treatment systems or if those systems failed. Future workers are evaluated using default parameters recommended by EPA as described in Section 4.4.

4.3 Calculation of Exposure Point Concentrations

This section presents the methodology that was employed to calculate the EPCs for the groundwater COPCs.

4.3.1 Exposure Point Concentrations of Samples Collected

For each single chemical in groundwater with at least 5 data points with 4 detected values, a 95 percent (or higher) upper confidence limit (UCL) on the arithmetic mean concentration is calculated and compared to the maximum detected concentration for that chemical. The lower value of the UCL and the maximum detected value is selected as the EPC, as recommended by EPA (1992). UCLs are not calculated for data sets with less than five data points and fewer than four detected concentrations. In such cases, maximum concentrations are used as the EPCs.

Several statistical methods can be used to estimate the UCL of a data set, depending upon the data distribution. Therefore, two key steps are required to estimate the UCL of a data set.

- Determine the distribution of the data (i.e., normal, lognormal, gamma, or neither)
- Compute the UCL using the appropriate procedure for the data distribution

In this assessment, both steps were performed with the ProUCL statistical software, version 5.1.02 (EPA 2015). The ProUCL program tests the normal, lognormal, gamma, and non-parametric distributions of each data set, and the UCLs are calculated with the statistical procedures recommended by EPA, based on the findings of Singh, Singh, and Engelhardt (1997, 1999) (EPA 2015). ProUCL computes the UCL using 5 parametric and 10 non-parametric methods, depending on the distribution.

- For normal distributions, the Student's t-statistic is used to calculate the UCL.
- For lognormal distributions, one of four different computation methods is used to calculate the UCL depending on the skewness of the data (as indicated by the standard deviation of the log-transformed data) and the sample size.

- For gamma distributions, one of two computation methods is used to calculate the UCL based on a "k value," which is the shape parameter of a gamma distribution. For values of k ≥ 0.1, the exposure point concentration term is computed using an adjusted gamma UCL of the mean (when 0.1 ≤ k ≤ 0.5) or an approximate gamma UCL of the mean (when k > 0.5). For values of k < 0.1, a UCL is obtained using either the bootstrap-t method or Hall's bootstrap method when the sample size is small (less than 15), or the approximate gamma for larger datasets.
- For data sets that do not fit a normal, lognormal, or gamma distribution, the ProUCL program calculates and recommends a UCL from 1 of the 10 non-parametric methods (EPA 2015).

Table B-3 in Appendix B presents the EPCs for each COPC in groundwater. As noted previously, the EPC is the lower value of the UCL and the maximum detected value. ProUCL outputs for COPCs are presented in Appendix C.

4.3.2 Indoor Air Exposure Point Concentrations Using the Shower Model

Modeling is required to estimate the indoor air concentrations of VOCs from groundwater while showering. In this scenario, receptors are assumed to inhale VOCs while showering and during time spent in the bathroom after showering. Dermal absorption of volatilized VOCs is assumed negligible due to low dermal permeabilities. Methodologies for estimating exposure to VOCs in domestic water supplies from the inhalation exposure route are based on a shower model developed by Schaum et al. (1994).

The shower model treats the bathroom as one compartment and yields an air concentration averaged over the time of the actual shower and the time spent in the bathroom after the shower. The model was derived by assuming that the chemical contaminant volatilizes at a constant rate and instantly mixes uniformly with the bathroom air and that ventilation with clean air does not occur. This implies that the chemical concentration in the air increases linearly from zero to a maximum level at the end of the shower and then remains constant during the time an individual spends in the bathroom immediately after showering.

The air concentration is estimated using the water concentration. The water concentration is a site-specific value that refers to the concentration of a chemical in water as it enters the shower. The UCL value or the maximum detected value is utilized as the water concentration (i.e., the EPC listed in Table B-3 in Appendix B). Chemical-specific fraction volatilized values are calculated from these chemical properties using the equation and values provided by Schaum et al. (1994) and EPA's standard default parameters (EPA 2011a) (see Tables D-1 and D-2 in Appendix D). Exposure point air concentrations from the shower model are presented in Tables D-3 and D-4 in Appendix D.

4.4 Exposure Parameter Assumptions

Exposure parameters for each scenario are primarily taken from EPA documents (EPA 1989, 2004, 2011a, and 2014a) and are consistent with EPA Region 2's approach. EPA's standard default assumptions (EPA 2014a) are used. Otherwise values from the most recent guidance available are used unless EPA Region 2 has a known preference for a specific value. RME and

central tendency exposure (CTE) equations and parameters used in the risk assessment are provided in Tables B-4.1a and B-4.1b in Appendix B. Chemical-specific dermal permeability coefficients for COPCs are presented in Table B-4.2.

4.4.1 Residents

Residents are assumed to be exposed to contaminants in groundwater. Standard default exposure assumptions are used for both RME and CTE scenarios for ingestion of, and dermal contact with, groundwater and inhalation of VOCs in groundwater while bathing or showering (Tables B-4.1a and B-4.1b).

Carcinogenic exposure estimates throughout a lifetime are impacted by age-dependent intake factors. To take into account the difference in daily ingestion rates, body weights, and exposure durations for young children and adults, age-adjusted intake factors are used for carcinogenic exposure estimates (EPA 2014a). This is accomplished by using factors for a child for the first 6 years of exposure and adult factors for the remaining 20 years of the exposure period. For noncancer exposure estimates, child exposure pathways are used since this is a more sensitive receptor.

4.2.2 Site Workers

Workers are assumed to be exposed to contaminants in groundwater. Standard default exposure assumptions are used for both RME and CTE scenarios for ingestion of groundwater (Tables B-4.1a and B-4.1b).

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Section 5
Toxicity Assessment

Health criteria used in this risk assessment were obtained from a variety of toxicological sources according to a hierarchy established in OSWER directive 9285.7-53 (EPA 2003). The toxicity value hierarchy is as follows:

- Tier 1 – EPA's Integrated Risk Information System (IRIS).
- Tier 2 – EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs): The Office of Research and Development/National Center for Environmental Assessment / Superfund Health Risk Technical Support Center develops PPRTVs on a chemical-specific basis when requested by EPA's Superfund program.
- Tier 3 – Other Toxicity Values: Tier 3 includes additional EPA and non-EPA sources of toxicity information such as the California Environmental Protection Agency (Cal/EPA) and the Agency for Toxic Substances and Disease Registry. Priority should be given to those sources of information that are the most current, the basis for which is transparent and publicly available, and which have been peer-reviewed.

5.1 Health Effects Criteria for Noncarcinogens

For chemicals that exhibit noncancer (e.g., systemic) effects, many authorities consider organisms to have repair and detoxification capabilities that must be exceeded by some critical concentration (threshold) before the health effect is manifested. This threshold view holds that a range of exposures from just above zero to some finite value can be tolerated by the organism without an appreciable risk of adverse effects.

Health criteria for chemicals exhibiting noncancer effects for use in risk assessments are generally EPA-derived reference doses (RfDs) and reference concentrations (RfCs). The RfD or RfC is an estimate of average daily exposure to an individual (including sensitive individuals) that is likely to be without appreciable risk of deleterious effects during a lifetime. The RfD is expressed in units of milligram of chemical per kilogram of body weight per day (mg/kg-day), whereas the RfC is expressed in units of mg chemical per cubic meter of air (mg/m^3).

RfDs and RfCs are usually derived either from human studies involving work-place exposures or from animal studies and are adjusted using uncertainty factors to ensure they are unlikely to underestimate the potential for adverse noncancer effects to occur. The uncertainty factors reflect scientific judgment regarding the various types of data used to estimate the RfD/RfC and range between 1 and 10. For example, a factor of 10 may be introduced to account for possible differences in response between humans and animals in prolonged exposure studies. Other factors of 10 may be used to account for variation in susceptibility among individuals in the human population, use of data from a study with less-than-lifetime exposure, and/or use of data from a study that did not identify a no-observed-adverse-effect level (NOAEL).

RfDs and RfCs provide benchmarks against which estimated doses (i.e., those projected from human exposures to various environmental conditions) might be compared. Doses that are significantly higher than the RfD/RfC may indicate an increased potential of hazard from the exposure, whereas doses that are less than the RfD/RfC are not likely to be associated with adverse health effects. Note that an exceedance of a reference dose or concentration does not predict a specific disease.

5.2 Health Effects Criteria for Carcinogens

For chemicals that exhibit cancer effects, EPA and other scientific authorities recognize that one or more molecular events can evoke changes in a single cell or a small number of cells that can lead to malignancy. This non-threshold theory of carcinogenesis purports that any level of exposure to a carcinogen can result in some finite possibility of causing cancer. Generally, regulatory agencies assume the non-threshold hypothesis for carcinogens in the absence of information concerning the mechanisms of cancer action for the chemical. The slope factor (SF) [in units of $(mg/kg\ body\ weight\text{-}day)^{-1}$] is a number which, when multiplied by the lifetime average daily dose of a potential carcinogen (in mg/kg body weight-day), yields the upper bound lifetime excess cancer risk associated with exposure at that dose. The SF is developed for exposure through the oral route.

When the units are risk per microgram per cubic meter ($\mu g/m^3$), it is called the inhalation unit risk (IUR). The IUR is the upper bound excess lifetime cancer risk estimated to result from continuous exposure to a chemical at a concentration of 1 $\mu g/m^3$ in air. Upper bound is a term used by EPA to reflect the conservative nature of the SFs and IURs—risks estimated using SFs and IURs are considered unlikely to underestimate actual risks and may overestimate risks for a given exposure. Excess lifetime cancer risks are generally expressed in scientific notation and are probabilities. An excess lifetime cancer risk of 1×10^{-6} (1 in 1 million), for example, represents the incremental probability that an individual will develop cancer as a result of exposure to a carcinogen over a 70-year lifetime under specified exposure conditions.

In practice, SF and IUR estimates are derived from the results of human epidemiology studies or chronic animal bioassays. The animal studies are conducted for a range of doses, including a high dose, to detect possible adverse effects. Since humans are expected to be exposed at lower doses than those used in animal studies, the data are adjusted via mathematical models. The data from animal studies are typically fitted to the linearized multistage model to obtain a dose-response curve. EPA evaluates a range of possible models based on the available data before conducting the extrapolation. The most appropriate model to reflect the data is selected based on an analysis of the data set.

The 95 percent UCL slope of the dose-response curve, subject to various adjustments and an inter-species scaling factor, is applied to derive the health protective SF and IUR estimate for humans. Dose-response data from human epidemiological studies are fitted to dose-time-response curves. These models provide rough, but reasonable, estimates of the upper limits on lifetime risk. SF and IUR estimates based on human epidemiological data are also derived using health protective assumptions and, as such, they too are considered unlikely to underestimate risks.

Therefore, while the actual risks associated with exposures to potential carcinogens are unlikely to be higher than the risks calculated using SF and IUR estimates, they could be considerably lower. In addition, there are varying degrees of confidence in the weight of evidence for carcinogenicity of a given chemical. EPA (1986) has proposed a system for characterizing the overall weight of evidence based on the availability of animal, human, and other supportive data. The weight-of-evidence classification is an attempt to determine the likelihood that an agent is a human carcinogen and thus qualitatively affects the estimation of potential health risks. Three major factors are considered in characterizing the overall weight of evidence for human carcinogenicity:

- The availability and quality of evidence from human studies
- The availability and quality of evidence from animal studies
- Other supportive information that is assessed to determine whether the overall weight of evidence should be modified

Under EPA's risk assessment guidelines (1986, 1996, and 1999), classification of the overall weight of evidence has the following five categories:

- Group A – Human Carcinogen: There is at least sufficient evidence from human epidemiological studies to support a causal association between an agent and cancer.
- Group B – Probable Human Carcinogen: There is at least limited evidence from epidemiological studies of carcinogenicity in humans (Group B1), or, in the absence of adequate data in humans, there is sufficient evidence of carcinogenicity in animals (Group B2).
- Group C – Possible Human Carcinogen: There is inadequate evidence of carcinogenicity in humans.
- Group D – Not Classified: There are inadequate data or no existing data for the chemical.
- Group E – No Evidence of Carcinogenicity in Humans: There is no evidence for carcinogenicity in at least two adequate animal tests in different species or in both epidemiological and animal studies.

The 2005 cancer guidelines (EPA 2005a) provides an update to the cancer guidelines (EPA 1986, 1996, and 1999). The 2005 cancer guidelines emphasize the value of understanding the biological changes that a chemical can cause and how these changes might lead to the development of cancer. They also discuss methods to evaluate and use such information, including information about an agent's postulated mode of action, or the series of steps and processes that lead to cancer formation. Mode-of-action data, when available and of sufficient quality, may be useful to draw conclusions about the potency of an agent, its potential effects at low doses, whether findings in animals are relevant to humans, and which populations or life stages may be particularly susceptible. In the absence of mode-of-action information, default options are available to allow the risk assessment to proceed.

The 2005 cancer guidelines recommend that an agent's human cancer potential be described in a weight-of-evidence narrative rather than the previously identified letter categories (A = known, B = probable, C = possible, D = not classifiable, and E = non-human carcinogen). The narrative summarizes the full range of available evidence and describes any conditions associated with conclusions about an agent's hazard potential. For example, the narrative may explain that an agent appears to be carcinogenic by some routes of exposure but not others (e.g., by inhalation but not ingestion). Similarly, a hazard may be attributed to exposures during sensitive life stages of development but not at other times. The narrative also summarizes uncertainties and key default options that have been invoked.

The following are the five recommended standard hazard descriptors:

- Carcinogenic to humans
- Likely to be carcinogenic to humans
- Suggestive evidence of carcinogenic potential
- Inadequate information to assess carcinogenic potential
- Not likely to be carcinogenic to humans

EPA is evaluating the carcinogenic weight of evidence of chemicals through the IRIS chemical process. In this process, chemicals are nominated, and all chemicals are evaluated consistent with the 2005 cancer guidelines (EPA 2005a) and a narrative developed describing the weight of evidence. The IRIS chemical file is then reviewed, first through internal EPA consensus review and then external peer-review. The requirements for in-depth analysis of mode-of-action data and the review process do not allow the equating of a chemical evaluated under the old system with the letter classification using the 2005 classification narrative; rather, a full analysis of the data is required.

The 2005 cancer guidelines also include supplemental guidance (EPA 2005b) on the evaluation of early lifetime exposures, including the mutagenic mode of action for carcinogenesis. The supplemental guidance provides procedures for evaluating chemicals that are carcinogens and either using the data in the development of the potency factors or using age dependent adjustment factors. For chemicals with mutagenic mode of action, the following ratio is applied to the chronic daily intake (EPA 2005b):

- Age 0 to less than 2 years: 10
- Age 2 to less than 16 years: 3
- Age greater than or equal to 16 years: 1

The supplemental guidance also provides for the evaluation of data on early lifetime exposures where children may be more susceptible. The application of these adjustments for specific chemicals is noted in the risk assessment and, where appropriate, in the presentation of calculated risks.

5.3 Toxicity Values

Tables 5-1 and 5-2 summarize the chronic RfDs and RfCs used to estimate noncancer effects. Tables 5-3 and 5-4 summarize the cancer SFs and IURs used to estimate cancer risks. These criteria are the most current data, obtained from the online version of IRIS, PPRTVs, and the Cal/EPA Office of Environmental Health Hazard Assessment Toxicity Criteria Database. The use of surrogate toxicity values is noted in Tables 5-1 through 5-4. TCE is considered carcinogenic by a mutagenic mode of action for induction of kidney tumors, which means those exposed to TCE are assumed to have increased early-life (< 16 years of age) susceptibility to kidney tumors (EPA 2011b). Dose estimates for this mutagen are adjusted upward to include both early-life exposures that may result in the occurrence of cancer during childhood and early-life exposures that may contribute to cancers later in life.

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Section 6
Risk Characterization

In this section of the risk assessment, the human health risks potentially associated with the complete human exposure pathway identified in Section 4 are assessed. Potential risks due to exposures to COPCs in groundwater from the site are evaluated by integrating toxicity and exposure assessments into quantitative expressions of cancer risk and noncancer health hazards.

The potential for noncancer health effects is evaluated by comparing an exposure level over a specified period with an RfD or RfC derived for a similar exposure period. This ratio of exposure to toxicity is referred to as an HQ. The hazard index (HI) is the sum of the HQs from individual chemicals and exposure routes. This HI assumes that there is a level of exposure below which it is unlikely even for sensitive populations to experience adverse health effects. If the HI exceeds unity (1), there may be concern for potential noncancer effects. However, this value should not be interpreted as a probability; generally, the greater the HI is above unity, the greater the level of concern.

Cancer risks are estimated as the incremental probability of an individual to develop cancer over a lifetime as a result of exposure to a potential carcinogen. The upper bound excess lifetime cancer risk is estimated by multiplying the lifetime exposure estimated in the exposure assessment (Section 4) by the SF or IUR identified in the toxicity assessment (Section 5). Excess lifetime cancer risks generally are expressed in scientific notation and are probabilities. An excess lifetime cancer risk of 1×10^{-6} (one in one million), for example, represents the incremental probability that an individual will develop cancer as a result of exposure to a cancer chemical over a 70-year lifetime under specified exposure conditions. Because there are multiple cancer types for TCE but the finding of a mutagenic mode of action applies to kidney only, cancer risks from TCE are calculated to account for increased early-life susceptibility for kidney cancer and contribution from other cancer types (EPA 2011b).

In general, EPA recommends a noncancer HI value of unity (1) and a cancer risk range of 1×10^{-6} to 1×10^{-4} as threshold values for potential human health impacts. The results presented in the spreadsheet calculations are compared to these values. Risks based on CTE assumptions are calculated only if the cancer risk and/or noncancer health hazard calculations under the RME scenario exceed EPA's threshold values. These values aid in determining whether additional response action is necessary at the site.

6.1 Results of Risk Calculations

Risks for all receptors are estimated using RME assumptions. Risks are also estimated using CTE assumptions when the RME assumptions resulted in risk estimates above EPA's thresholds. The comparison of RME and CTE risks provides information about the degree to which variability in and uncertainty associated with receptor behavior (e.g., amount of water a child ingests per day) influence the risk estimates. CTE risks represent typical exposure patterns rather than an upper bound exposure that is reasonably expected to occur (i.e., RME). Cancer risks from TCE are

presented in Table B-7.0 in Appendix B and Table F-1.0 in Appendix F for RME and CTE scenarios, respectively. Cancer risk and noncancer health hazard calculations based on the RME scenario for all COPCs are presented in RAGS Part D Table B-7 series and summarized in RAGS Part D Tables B-9 and B-10 series in Appendix B. Cancer risk and noncancer health hazard calculations based on the CTE scenario are presented in Appendix F. Cancer risk and noncancer health hazard estimates are summarized in Table 6-1.

6.1.1 Residents

Future residents could come into contact with contaminants in groundwater. The total cancer risk for residents (2×10^{-3}) is above EPA's acceptable cancer risk range under the RME scenario. Cancer risks are due primarily to exposure to VC (77 percent) and TCE (15 percent). Under the CTE scenario, the total cancer risk for residents (4×10^{-4}) remains above EPA's acceptable cancer risk range. Cancer risks are due primarily to exposure to VC (3×10^{-4}). Vinyl chloride was only detected in 1 of 13 data points, so the estimated risk may be overestimated.

Under the RME scenario for the child, the total HI (67) is above EPA's threshold of unity. The target organ/effect HIs for the kidney and liver (65), development (54), heart and immune system (53), nervous system (12), central nervous system (CNS) (11), and lung (2) are greater than 1. RME exposure values are primarily associated with potential exposure to TCE (53) and PCE (11) and to a lesser extent cobalt (1). Under the CTE scenario, the total noncancer HI (16) is still above EPA's threshold of unity. The target organ/effect HIs for the liver and kidney (14), development, heart and immune system (11), and nervous system and CNS (4) are greater than 1. CTE values are primarily associated with potential exposure to TCE (11) and PCE (4).

6.1.2 Site Workers

Future site workers may come into contact with contaminants in groundwater. The total cancer risk for future worker (2×10^{-4}) is above EPA's acceptable cancer risk range under the RME scenario but within EPA's acceptable cancer risk range under the CTE scenario (4×10^{-5}). Cancer risks are due primarily to exposure to TCE.

The total HI (8) for future workers under the RME scenario is above EPA's threshold of unity. The target organ/effect HIs for the kidney and liver (7), development (6), heart and immune system (5), and nervous system (2) are greater than 1. RME exposure values are primarily associated with potential exposure to TCE (5) and PCE (1). Under the CTE scenario, the total noncancer HI (3) is still above EPA's threshold of unity. The target organ/effect HIs (2) for the liver, kidney, development, heart, and immune system are greater than 1. CTE values are primarily associated with potential exposure to TCE (2).

6.2 Risk Associated with Exposure to Lead

As shown in Table 3-2, the maximum detected lead groundwater concentration of 3.8 µg/L is below the lead Federal Action Level of 15 µg/L. Thus, risks due to lead exposure to residents most likely is not a concern.

6.3 Risk Associated with Vapor Intrusion

Future residents and site workers potentially may be exposed to volatile COPCs via inhalation of vapor emanating from groundwater into enclosed structures via vapor intrusion. A vapor intrusion screening was performed on the groundwater concentrations in Table E-1 in Appendix E. The groundwater concentrations used for the screening were the maximum concentrations from samples collected at depth (>100 feet bgs). Based on the screening, several chemicals exceeded the screening values, including TCE and PCE. However, as part of OU1, EPA conducted a vapor intrusion evaluation at the site. No indoor air samples were above levels of concern in any of the structures sampled. As a result, EPA does not expect to perform any further vapor intrusion sampling at the site.

6.4 Uncertainty in Risk Assessment

As in any risk assessment, the estimates of potential health threats (cancer risks and noncancer health hazards) have numerous associated uncertainties. The primary areas of uncertainty and limitations are qualitatively discussed here. The main areas of uncertainty in this HHRA include environmental data, exposure parameter assumptions, toxicological data, and risk characterization.

6.4.1 Environmental Data

Uncertainty is often associated with the estimation of chemical concentrations. Errors in the analytical data may stem from errors inherent in sampling and/or laboratory procedures. One of the most effective methods to minimize procedural or systematic error is to subject the data to a strict QC review. The QC review procedure helps to eliminate many laboratory errors. However, even with all data rigorously validated, it must be realized that error is inherent in all laboratory procedures.

Samples were collected from known and suspected areas of contamination (biased sampling) to delineate the nature and extent of contamination. Although this sampling methodology provided a reasonable estimation of the level of confidence at known or suspected contaminated areas within the site, the possibility exists that the data sets formed by these samples do not accurately represent the level of overall contamination at the site. The large number of samples collected at the site reduces uncertainty to an acceptable level in most cases.

Among the factors that should be considered is the ability to estimate risk in the future. The presumption that contaminant concentrations will remain the same over time most likely overestimates the potential risk because dispersion and natural attenuation processes may occur.

Finally, some uncertainty is associated with the use of one round of sampling data. The use of at least two rounds of sampling is generally recommended (EPA 2014b) to be representative of current site conditions. The use of data from one round of sampling may over- or underestimate long-term average concentrations and associated risks.

6.4.2 Exposure Parameter Estimation

There are two major areas of uncertainty associated with exposure parameter estimation. The first relates to the calculation of EPCs. The second relates to parameter values used to estimate chemical intake.

6.4.2.1 Exposure Point Concentrations

A baseline risk assessment evaluates statistically derived mean concentrations over an exposure area, considering all exposures within that area as equally possible. Risks associated with exposures are then assessed by combining the statistically derived mean concentrations with exposure factors and the appropriate exposure/toxicity values to calculate potential risks and hazards.

In accordance with EPA's recommendation as implemented in ProUCL (EPA 2015), when 5 or more samples are collected with a chemical detected in at least 4 samples, the EPC for a specific chemical in a particular medium is based on the 95 percent or higher UCL on the mean or the maximum detected concentration, whichever is less. Use of a 95 percent or higher UCL of the mean is simply to ensure that the average concentration is not underestimated. At this site, only two data points are available for use in the EPC determinations for inorganics. In addition, vinyl chloride was only detected in 1 of 13 data points. Thus, the limited number of data points resulted in the use of the maximum detected concentrations of the data point results as EPCs. The use of maximum concentrations most likely overestimates long-term exposures.

When calculating EPCs from sampling data, any approach dealing with non-detected chemical concentrations is associated with some degree of uncertainty. This is because the non-detected result does not indicate whether the chemical is absent from the medium, present at a concentration just above zero, or present at a concentration just below the reporting limit. For chemicals that are infrequently detected, many of the values used to estimate the EPCs are based on reporting limits. High reporting limits for non-detects can lead to overestimation of risk if the actual concentrations are well below the reporting limit. However, reporting limits for the COPCs were generally toward the lower end of the detected concentrations, so the 95 percent or higher UCLs on the mean were minimally influenced by the reporting limits.

For the groundwater EPC calculation, OSWER recommends using the highest detected concentrations from samples at each location (EPA 2014b). For each monitoring well location, maximum concentrations from samples collected at multiple depths in a multi-port well or maximum concentrations from paired monitoring wells were used. Thus, using the maximum concentration from multiple depths in a multi-port well or from paired monitoring wells might overestimate the groundwater EPC. This may also overestimate the vapor intrusion evaluation since most of the highest concentrations are from deeper samples (>100 feet bgs).

6.4.2.2 Exposure Parameters

Uncertainty is associated with the exposure parameter values used; however, assumptions are chosen to be conservative so as not to underestimate risk. For example, assumptions are made for the exposure time, frequency, and duration of potential chemical exposures as well as for the quantity of material ingested, inhaled, or absorbed. In general, assumptions are made based on

reasonable maximum exposures and, in most cases, values are specified by EPA Region 2, EPA guidance documents, or site-specific information.

The choices made for exposure parameters are protective and unlikely to underestimate risks. Due to this, cancer risks and health hazards could be overestimated based on use of conservative exposure parameters in estimating risks.

Vapor concentrations in bathrooms were modeled using the shower model. The model is very conservative; thus, this approach tends to produce conservative indoor air concentrations that could result in overestimation of actual risk to future residents.

6.4.3 Toxicity Values

A potentially large source of uncertainty is inherent in the derivation of EPA toxicity values (i.e., RfDs, RfCs, SFs, and IURs). In many cases, data are extrapolated from animals to sensitive humans by the application of uncertainty factors to an estimated NOAEL or lowest-observed-adverse-effect level for noncancer health effects. While designed to be protective, it is likely in many cases that uncertainty factors overestimate the magnitude of differences that may exist between humans and animals and among humans. Alternatively, toxicity criteria may be based on studies that did not detect the most sensitive adverse effects. For example, many studies have not measured possible toxic effects on the immune system. Moreover, some chemicals may cause subtle effects not easily recognized in animal studies. The effects of lead on cognitive function and behavior at very low levels of exposure serve as examples.

In addition, derivation of cancer SFs often involves linear extrapolation of effects at high doses to potential effects at lower doses commonly seen in environmental exposure settings. Currently, it is not known whether linear extrapolation is appropriate. It is probable that the shape of the dose response curve for carcinogenesis varies with different chemicals and mechanisms of action. It is not possible at this time, however, to describe such differences in quantitative terms. It is likely that the assumption of linearity is conservative and yields SFs that are unlikely to lead to underestimation of risks. Yet, for specific chemicals, current methodology could cause SFs and, hence, risks to be over- or underestimated.

Furthermore, toxicity values are often based on observed dose-response relationships when the chemical is dissolved in water or is in some other readily soluble form. For instance, the oral SF for arsenic is based on exposure of a large Taiwanese population to dissolved arsenic in drinking water. In this risk assessment, intakes are not adjusted for relative bioavailability, which most likely overestimate risks.

Chromium can exist in several oxidation states ranging from chromium (II) to hexavalent chromium (VI). Only two oxidation states, chromium (III) and chromium (VI), are widely studied because of their predominance and stability in the ambient environment and their toxicological characteristics. Chromium (III) is poorly absorbed, regardless of the route of exposure, whereas chromium (VI) is more readily absorbed. Toxicological studies show that chromium (VI) is generally more toxic than chromium (III). Chromium (VI) is classified as a Group A – known human carcinogen by the inhalation route of exposure (EPA 2015). This risk assessment utilized an oral SF of 0.5 per mg/kg-day for chromium (VI) developed by the New Jersey Department of Environmental Protection. Total chromium, not valence-specific, data were collected from the

site. In the absence of valence-specific data, total chromium is evaluated in the HHRA using the chromium (VI) toxicity criteria. This assumption is very conservative since chromium in the environment is generally dominated by the much less toxic trivalent form. Thus, the use of chromium (VI) toxicity values overestimates the risk attributed to total chromium.

6.4.4 Risk Characterization

There is also uncertainty in assessing the risks associated with a mixture of chemicals. In this assessment, the effects of exposure to each contaminant present initially have been considered separately. However, these substances occur together at the site, and individuals may be exposed to mixtures of the chemicals. Predictions of how these mixtures of chemicals will interact must be based on an understanding of the mechanisms of such interactions. Individual chemicals may interact chemically in the body, yielding a new toxic component or causing different effects at different target organs. Suitable data are not currently available to rigorously characterize the effects of chemical mixtures. Consequently, as recommended by EPA (1989), chemicals present at the site are assumed to act additively, and potential health risks are evaluated by summing excess lifetime cancer risks and calculating HIs for noncancer health effects. This approach to assessing risk associated with mixtures of chemicals assumes that there are no synergistic or antagonistic interactions among the chemicals and that all chemicals have the same toxic endpoint and mechanisms of action. To the extent that these assumptions are correct, the actual risks could be underestimated or overestimated.

Because of the uncertainties described above, the risk assessment should be viewed as presenting an estimate of the potential risks and hazards associated with exposure to contaminated media. The results provide a conservative analysis intended to indicate the potential for adverse impacts to occur based on the RME and CTE scenarios.

Section 7
Summary and Conclusions

COPCs are identified based on criteria outlined in RAGS (EPA 1989), primarily through comparison of maximum detected concentrations to risk-based screening levels, followed by quantitative assessment of noncancer hazards and cancer risks.

In the HHRA, contaminants in groundwater at the site are evaluated for potential health threats to future residents and site workers. Exposure routes are identified, and quantitative estimates of the magnitude, frequency, and duration of exposure are made. Exposure point concentrations are estimated using the lower of the UCL and the maximum detected concentration. Daily intakes are calculated based on the RME scenario (the highest exposure reasonably expected to occur at a site). The intent is to estimate a conservative exposure case that is still within the range of possible exposures. CTE assumptions are also developed, which reflect more typical exposures.

In the toxicity assessment, current toxicological human health data (i.e., RfDs, RfCs, SFs, and IURs) are obtained from various sources and utilized in the order specified by EPA (2003).

Risk characterization involves integrating the exposure and toxicity assessments into quantitative expressions of risks/health effects. Specifically, daily intakes are compared with concentrations known or suspected to present health risks or hazards. The estimates of cancer risk and noncancer health hazards, and the greatest chemical contributors to these estimates, are identified. In general, EPA recommends an acceptable cancer risk range of 1×10^{-6} to 1×10^{-4} and noncancer HI of unity as threshold values for potential human health impacts (EPA 1989). These values aid in determining whether additional response action is necessary at the site.

The total cancer risks for residents are above EPA's acceptable cancer risk range for the RME (2×10^{-3}) and CTE (4×10^{-4}) scenarios, primarily due to VC and TCE in groundwater. The estimated cancer risks may be overestimated because VC was only detected in 1 out of 13 data points. Estimated cancer risk for site workers under RME scenario (2×10^{-4}) is above EPA's acceptable cancer risk range but within EPA's acceptable cancer risk range under the CTE scenario (4×10^{-5}).

The total HIs for future residents and site worker are above unity for both the RME and CTE scenarios, and are driven primarily by potential exposure to TCE and PCE in groundwater. The elevated HIs for the following organs/effects are primarily the result of exposure to TCE and PCE in groundwater: kidney, liver, development, heart, immune system, nervous system, and CNS.

Lead was evaluated separately and does not appear to be a concern for all receptors. Results of vapor intrusion evaluation indicated that future site workers and residents potentially might be exposed to volatile COPCs via inhalation of vapor emanating from groundwater into enclosed structures via vapor intrusion. However, no indoor air samples were above levels of concern in any of the structures sampled as part of the OU1 vapor intrusion evaluation. Thus, EPA does not expect to perform any further vapor intrusion sampling at the site.

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Section 8
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Tables

TABLE 3-1
LIST OF CHEMICALS OF POTENTIAL CONCERN
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Volatile Organic Compounds
1,1-Dichloroethane
1,1-Dichloroethene
Benzene
Carbon Tetrachloride
Chloroform
cis-1,2-Dichloroethene
Ethylbenzene
Methyl Tert-Butyl Ether
Tetrachloroethene
Trichloroethene
Vinyl Chloride
Inorganics
Arsenic
Chromium
Cobalt
Vanadium
Zinc

TABLE 3-2
LEAD WORKSHEET
Site Name: Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2, Garden City, New York
Receptor: Resident (Adult and Child [birth to <6 years])

A. EXPOSURE SCENARIO: RESIDENTIAL

1. Lead Screening Questions

Medium	Maximum Concentration		Screening Level		Basis for Screening Level Value
	Value	Unit	Value	Unit	
Groundwater	3.9	µg/L	15	µg/L	Federal Action Level

Note: If the Adult Lead Model is used, designate the baseline blood lead level and geometric standard deviation used to calculate the screening level.

2. Lead Model Questions

Question	Response for Non-Residential Lead Model
Was a lead model used? (If "no" explain rationale)	No. The maximum lead concentration is below the screening level. Therefore, further analysis using a lead model is not warranted.
Which lead model and what version/date was used?	NA
Where are the input values located in the risk assessment report?	NA
Where are the output values located in the risk assessment report?	NA
Was the model run using default values only?	NA
If non-default values were used, where are the rationale for those values located in the risk assessment report?	NA

3. Final Result

Medium	Result	Comment
NA	NA	NA

TABLE 3-2
LEAD WORKSHEET
Site Name: Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2, Garden City, New York
Receptor: Site Worker (Adult)

B. EXPOSURE SCENARIO: NON-RESIDENTIAL

1. Lead Screening Questions

Medium	Maximum Concentration		Screening Level		Basis for Screening Level Value
	Value	Unit	Value	Unit	
Groundwater	3.9	µg/L	15	µg/L	Federal Action Level

Note: If the Adult Lead Model is used, designate the baseline blood lead level and geometric standard deviation used to calculate the screening level.

2. Lead Model Questions

Question	Response for Non-Residential Lead Model
Was a lead model used? (If "no" explain rationale)	No. The maximum lead concentration is below the screening level. Therefore, further analysis using a lead model is not warranted.
Which lead model and what version/date was used?	NA
Where are the input values located in the risk assessment report?	NA
Where are the output values located in the risk assessment report?	NA
Was the model run using default values only?	NA
If non-default values were used, where are the rationale for those values located in the risk assessment report?	NA

3. Final Result

Medium	Result	Comment
NA	NA	NA

TABLE 4-1
SELECTION OF EXPOSURE PATHWAYS
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor (Age)	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Groundwater	Groundwater	Resident	Adult and Child (birth to <6 yrs)	Dermal	Quant	Private wells could be installed in the future or if the municipalities removed the treatment systems or if those systems failed.
						Ingestion	Quant	Private wells could be installed in the future or if the municipalities removed the treatment systems or if those systems failed.
						Inhalation	Quant	Private wells could be installed in the future or if the municipalities removed the treatment systems or if those systems failed.
				Site Worker	Adult	Ingestion	Quant	Private wells could be installed in the future or if the municipalities removed the treatment systems or if those systems failed.
		Indoor Air	Indoor Air	Resident	Adult and Child (birth to <6 yrs)	Inhalation	Quant	Residential homes could be located on the site in the future and residents could be exposed via inhalation of vapors from subsurface intrusion. Groundwater concentrations are screened against the Vapor Intrusion Screening Levels in the risk assessment.
				Site Worker	Adult	Ingestion	Quant	Site workers could be exposed via inhalation of vapors from subsurface intrusion if private wells are installed. Groundwater concentrations are screened against the Vapor Intrusion Screening Levels in the risk assessment.

Note:
Quant = Quantitative risk analysis performed

TABLE 5-1

NONCANCER TOXICITY DATA - ORAL/DERMAL

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal [1]	Absorbed RfD for Dermal [2]		Primary Target Organ	Combined Uncertainty/ Modifying Factor	Source	Date [3]
		Value	Unit		Value	Unit				
Volatile Organic Compounds										
1,1-Dichloroethane	Chronic	2.0E-01	mg/kg-day	1	2.0E-01	mg/kg-day	Kidney	3,000	PPRTV	9/27/2006
1,1-Dichloroethene	Chronic	5.0E-02	mg/kg-day	1	5.0E-02	mg/kg-day	Liver	100	IRIS	3/14/2017
Benzene	Chronic	4.0E-03	mg/kg-day	1	4.0E-03	mg/kg-day	Blood	300	IRIS	3/14/2017
Carbon Tetrachloride	Chronic	4.0E-03	mg/kg-day	1	4.0E-03	mg/kg-day	Liver/Kidney	1,000	IRIS	3/14/2017
Chloroform	Chronic	1.0E-02	mg/kg-day	1	1.0E-02	mg/kg-day	Liver	100	IRIS	3/14/2017
cis-1,2-Dichloroethene	Chronic	2.0E-03	mg/kg-day	1	2.0E-03	mg/kg-day	Kidney	3,000	IRIS	3/14/2017
Ethylbenzene	Chronic	1.0E-01	mg/kg-day	1	1.0E-01	mg/kg-day	Liver/Kidney	1,000	IRIS	3/14/2017
Methyl Tert-Butyl Ether	Chronic	NA	NA	1	NA	NA	NA	NA	NA	NA
Tetrachloroethene	Chronic	6.0E-03	mg/kg-day	1	6.0E-03	mg/kg-day	Nervous System/Liver/Kidney	1,000	IRIS	3/14/2017
Trichloroethene	Chronic	5.0E-04	mg/kg-day	1	5.0E-04	mg/kg-day	Heart/ Immune System/ Developmental/Kidney	10 to 1,000	IRIS	3/14/2017
Vinyl Chloride	Chronic	3.0E-03	mg/kg-day	1	3.0E-03	mg/kg-day	Liver	30	IRIS	3/14/2017
Inorganics										
Arsenic	Chronic	3.0E-04	mg/kg-day	1	3.0E-04	mg/kg-day	Skin	3	IRIS	3/14/2017
Chromium[4]	Chronic	3.0E-03	mg/kg-day	0.025	7.5E-05	mg/kg-day	None reported	300	IRIS	3/14/2017
Cobalt	Chronic	3.0E-04	mg/kg-day	1	3.0E-04	mg/kg-day	Thyroid	3,000	PPRTV	8/25/2008
Vanadium[5]	Chronic	9.0E-03	mg/kg-day	0.026	2.3E-04	mg/kg-day	Hair	100	IRIS	3/14/2017
Zinc	Chronic	3.0E-01	mg/kg-day	1	3.0E-01	mg/kg-day	Developmental	3	IRIS	3/14/2017

[1] Oral Absorption Efficiency for Dermal from Regional Screening Levels, May 2016
http://www.epa.gov/region09/waste/sfund/prg/index.html

[2] Adjusted RfD for Dermal = Oral RfD x Oral Absorption Efficiency for Dermal.

[3] Date shown for IRIS is the date IRIS was searched. http://www.epa.gov/iris/
Date shown for other sources is the publication date.

[4] based on chromium (VI)

[5] based on vanadium pentoxide

Definition:
IRIS = Integrated Risk Information System
mg/kg-day = milligram per kilogram per day
PPRTV = Provisional Peer Reviewed Toxicity Value
RfD = reference dose

TABLE 5-2

NONCANCER TOXICITY DATA - INHALATION

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Chemical of Potential Concern	Inhalation RfC		Primary Target Organ	Combined Uncertainty/ Modifying Factor	RfC Target Organ	
	Value	Unit			Source	Date [1]
Volatile Organic Compounds						
1,1-Dichloroethane	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	2.0E-01	mg/m^3	Liver	30	IRIS	3/14/2017
Benzene	3.0E-02	mg/m^3	Blood	300	IRIS	3/14/2017
Carbon Tetrachloride	1.0E-01	mg/m^3	Liver	100	IRIS	3/14/2017
Chloroform	3.0E-01	mg/m^3	Alimentary System/Kidney/Developmental	300	Cal/EPA	2/1/2012
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA
Ethylbenzene	1.0E+00	mg/m^3	Developmental	300	IRIS	3/14/2017
Methyl Tert-Butyl Ether	3.0E+00	mg/m^3	Liver/Kidney	100	IRIS	3/14/2017
Tetrachloroethene	4.0E-02	mg/m^3	CNS/Liver/Kidney	1,000	IRIS	3/14/2017
Trichloroethene	2.0E-03	mg/m^3	Heart/Immune System/Liver	10 to 100	IRIS	3/14/2017
Vinyl Chloride	1.0E-01	mg/m^3	Liver	30	IRIS	3/14/2017
Inorganics						
Arsenic	1.5E-05	mg/m^3	Developmental/Cardiovascular System/ Nervous System/Lung/Skin	30	Cal/EPA	2/1/2012
Chromium[2]	8.0E-06	mg/m^3	Lung	300	IRIS	3/14/2017
Cobalt	6.0E-06	mg/m^3	Respiratory System/Lung	300	PPRTV	8/25/2008
Vanadium[3]	7.0E-06	mg/m^3	Respiratory System	300	PPRTV	4/30/2008
Zinc	NA	NA	NA	NA	NA	NA

[1] Date shown for IRIS is the date IRIS was searched. http://www.epa.gov/iris/
Date shown for other sources is the publication date.

[2] based on chromic acid mists and dissolved chromium (VI) aerosols

[3] based on vanadium pentoxide

Definition:

Cal/EPA = California Environmental Protection Agency

CNS = central nervous system

IRIS = Integrated Risk Information System

mg/m^3 = milligram per cubic meter

PPRTV = Provisional Peer Reviewed Toxicity Value

RfC = reference concentration

TABLE 5-3

CANCER TOXICITY DATA - ORAL/DERMAL

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Chemical of Potential Concern	Oral Slope Factor		Oral Absorption Efficiency for Dermal [1]	Absorbed Slope Factor for Dermal [2]		Mutagen [3]	Weight of Evidence/ Cancer Guideline Description	Source	Date [4]
	Value	Unit		Value	Unit				
Volatile Organic Compounds									
1,1-Dichloroethane	5.7E-03	$(mg/kg\text{-}day)^{-1}$	1	5.7E-03	$(mg/kg\text{-}day)^{-1}$	--	C	Cal/EPA	6/1/2009
1,1-Dichloroethene	NA	NA	1	NA	NA	--	C	IRIS	3/14/2017
Benzene	5.5E-02	$(mg/kg\text{-}day)^{-1}$	1	5.5E-02	$(mg/kg\text{-}day)^{-1}$	--	A	IRIS	3/14/2017
Carbon Tetrachloride	7.0E-02	$(mg/kg\text{-}day)^{-1}$	1	7.0E-02	$(mg/kg\text{-}day)^{-1}$	--	likely to be carcinogenic to humans	IRIS	3/14/2017
Chloroform	3.1E-02	$(mg/kg\text{-}day)^{-1}$	1	3.1E-02	$(mg/kg\text{-}day)^{-1}$	--	B2	Cal/EPA	6/1/2009
cis-1,2-Dichloroethene	NA	NA	1	NA	NA	--	inadequate information to assess the carcinogenic potential	IRIS	3/14/2017
Ethylbenzene	1.1E-02	$(mg/kg\text{-}day)^{-1}$	1	1.1E-02	$(mg/kg\text{-}day)^{-1}$	--	D	Cal/EPA	6/1/2009
Methyl Tert-Butyl Ether	1.8E-03	$(mg/kg\text{-}day)^{-1}$	1	1.8E-03	$(mg/kg\text{-}day)^{-1}$	--	3	Cal/EPA	6/1/2009
Tetrachloroethene	2.1E-03	$(mg/kg\text{-}day)^{-1}$	1	2.1E-03	$(mg/kg\text{-}day)^{-1}$	--	likely to be carcinogenic to humans	IRIS	3/14/2017
Trichloroethene[5]	4.6E-02	$(mg/kg\text{-}day)^{-1}$	1	4.6E-02	$(mg/kg\text{-}day)^{-1}$	M	carcinogenic to humans	IRIS	3/14/2017
Vinyl Chloride[6]	7.2E-01	$(mg/kg\text{-}day)^{-1}$	1	7.2E-01	$(mg/kg\text{-}day)^{-1}$	M	A	IRIS	3/14/2017
Inorganics									
Arsenic	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1	1.5E+00	$(mg/kg\text{-}day)^{-1}$	--	A	IRIS	3/14/2017
Chromium[7]	5.0E-01	$(mg/kg\text{-}day)^{-1}$	0.025	5.0E-01	$(mg/kg\text{-}day)^{-1}$	--	likely to be carcinogenic to humans	NJDEP	4/8/2009
Cobalt	NA	NA	1	NA	NA	--	NA	NA	NA
Vanadium	NA	NA	0.026	NA	NA	--	inadequate information to assess the carcinogenic potential	PPRTV	9/30/2009
Zinc	NA	NA	1	NA	NA	--	D	IRIS	3/14/2017

[1] Oral Absorption Efficiency for Dermal from Regional Screening Levels, May 2016
http://www.epa.gov/region09/waste/sfund/prg/index.html

[2] Oral slope factor (SF) for Dermal = Oral SF

[3] Identified as a mutagen on the Regional Screening Level Table, May 2016

[4] Date shown for IRIS is the date IRIS was searched. http://www.epa.gov/iris/
Date shown for other sources is the publication date.

[5] Trichloroethene is considered carcinogenic by a mutagenic mode of action for induction of kidney tumors.
The adult-based oral SF for kidney cancer is 9.3×10^{-3} per mg/kg/day

[6] Oral SF listed is based on continuous lifetime exposure during adulthood.
The oral SF for the continuous lifetime exposure from birth is 1.4 per mg/kg/day.

[7] based on chromium (VI)

EPA Weight of Evidence (EPA 1986, EPA 1996):

A - Human Carcinogen

B1 - Probable human carcinogen
indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as human carcinogen

Definition:

Cal/EPA = California Environmental Protection Agency

IRIS = Integrated Risk Information System

mg/kg-day = milligram per kilogram per day

NA = not available

NJDEP = New Jersey Department of Environmental Protection

PPRTV = Provisional Peer Reviewed Toxicity Value

EPA Weight of Evidence Narrative (EPA 2005):

Carcinogenic to human

Likely to be carcinogenic to humans

Suggestive evidence of carcinogenic potential

Inadequate information to assess carcinogenic potential

Not likely to be carcinogenic to humans

IARC Classification:

3 - Not classifiable

TABLE 5-4
CANCER TOXICITY DATA - INHALATION
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Chemical of Potential Concern	Inhalation Unit Risk		Mutagen [1]	Weight of Evidence/ Cancer Guideline Description	Inhalation Unit Risk	
	Value	Unit			Source	Date [2]
Volatile Organic Compounds						
1,1-Dichloroethane	1.6E-06	$(\mu g/m^3)^{-1}$	--	C	Cal/EPA	6/1/2009
1,1-Dichloroethene	NA	NA	--	C	IRIS	3/14/2017
Benzene	7.8E-06	$(\mu g/m^3)^{-1}$	--	A	IRIS	3/14/2017
Carbon Tetrachloride	6.0E-06	$(\mu g/m^3)^{-1}$	--	likely to be carcinogenic to humans	IRIS	3/14/2017
Chloroform	2.3E-05	$(\mu g/m^3)^{-1}$	--	B2	IRIS	3/14/2017
cis-1,2-Dichloroethene	NA	NA	--	inadequate information to assess the carcinogenic potential	IRIS	3/14/2017
Ethylbenzene	2.5E-06	$(\mu g/m^3)^{-1}$	--	D	Cal/EPA	6/1/2009
Methyl Tert-Butyl Ether	2.6E-07	$(\mu g/m^3)^{-1}$	--	3	Cal/EPA	6/1/2009
Tetrachloroethene	2.6E-07	$(\mu g/m^3)^{-1}$	--	likely to be carcinogenic to humans	IRIS	3/14/2017
Trichloroethene[3]	4.1E-06	$(\mu g/m^3)^{-1}$	M	carcinogenic to humans	IRIS	3/14/2017
Vinyl Chloride[4]	4.4E-06	$(\mu g/m^3)^{-1}$	M	A	IRIS	3/14/2017
Inorganics						
Arsenic	4.3E-03	$(\mu g/m^3)^{-1}$	--	A	IRIS	3/14/2017
Chromium[5]	1.2E-02	$(\mu g/m^3)^{-1}$	--	A	IRIS	3/14/2017
Cobalt	9.0E-03	$(\mu g/m^3)^{-1}$	--	likely to be carcinogenic to humans	PPRTV	8/25/2008
Vanadium[6]	8.3E-03	$(\mu g/m^3)^{-1}$	--	suggestive evidence of carcinogenic potential	PPRTV	4/30/2008
Zinc	NA	NA	--	D	IRIS	3/14/2017

[1] Idenitified as a mutagen on the Regional Screening Level (RSL) Table, May 2016, http://www.epa.gov/region09/waste/sfund/prg/index.html

[2] Date shown for IRIS is the date IRIS was searched. http://www.epa.gov/iris/ Date shown for other sources is the publication date.

[3] TCE is considered carcinogenic by a mutagenic mode of action for induction of kidney tumors. The adult-based IUR for kidney cancer is 1×10^{-6} per $\mu g/m^3$.

[4] IUR listed is based on continuous lifetime exposure during adulthood
The IUR for the continuous lifetime exposure from birth is 8.8×10^{-6} per $\mu g/m^3$.

[5] based on chromium (VI)

[6] based on vanadium pentoxide

EPA Weight of Evidence (EPA 1986, EPA 1996):
A - Human Carcinogen
B1 - Probable human carcinogen
indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as human carcinogen

Definition:
Cal/EPA = California Environmental Protection Agency
IRIS = Integrated Risk Information System
NA = not available
PPRTV = Provisional Peer Reviewed Toxicity Value
$\mu g/m^3$ = microgram per cubic meter

EPA Weight of Evidence Narrative (EPA 2005):
Carcinogenic to human
Likely to be carcinogenic to humans
Suggestive evidence of carcinogenic potential
Inadequate information to assess carcinogenic potential
Not likely to be carcinogenic to humans

IARC Classification:
3 - Not classifiable

TABLE 6-1
RISK SUMMARY
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Time Frame	Exposure Medium	Receptor	Cancer Risk [1]				Noncancer Hazard Index [2]			
			RME	Risk Driver	CTE	Risk Driver	RME	Organ/Effect (Risk Driver)	CTE	Organ/Effect (Risk Driver)
Future	Groundwater	Resident [3]	**2×10^{-3}**	TCE (3×10^{-4}) VC (2×10^{-3})	**4×10^{-4}**	TCE (3×10^{-4}) VC (2×10^{-3})	**67**	HI CNS: 11 (PCE) HI Development: 54 (TCE) HI Heart: 53 (TCE) HI Immune System: 53 (TCE) HI Kidney: 65 (TCE, PCE) HI Liver: 65 (TCE, PCE) HI Lung: 2 (cobalt) HI Nervous System: 12 (PCE)	**16**	HI CNS: 4 (PCE) HI Developmental: 11 (TCE) HI Heart: 11 (TCE) HI Immune System: 11 (TCE) HI Kidney: 14 (TCE, PCE) HI Liver: 14 (TCE, PCE) HI Nervous System: 4 (PCE)
		Site Worker	**2×10^{-4}**	TCE (1×10^{-4})	4×10^{-5}	--	**8**	HI Development: 6 (TCE) HI Heart: 5 (TCE) HI Immune System: 5 (TCE) HI Kidney: 7 (TCE, PCE) HI Liver: 7 (TCE, PCE) HI Nervous System: 2 (PCE)	**3**	HI Developmental: 2 (TCE) HI Heart: 2 (TCE) HI Immune System: 2 (TCE) HI Kidney: 2 (TCE) HI Liver: 2 (TCE)

RME = reasonable maximum exposure
CTE = central tendency exposure
TCE = trichloroethene
PCE = tetrachloroethene
VC = vinyl chloride

[1] bolded values exceed EPA's target range of $1x10^{-6}$ to $1x10^{-4}$
[2] bolded values exceed EPA's threshold of unity (1)
[3] cancer risk is based on age-adjusted scenario and noncancer hazard index is based on child exposure scenario

Figures

adapted from New York State Department of Environmental Conservation Interactive Mapping Gateway: http://www.nygis.state.ny.us/gateway/index.html

2 Miles

Figure 2-1
Site Location Map
Old Roosevelt Field
Contaminated Groundwater Area Site, Operable Unit 2
Garden City, Nassau County, New York

Old Roosevelt Field Contaminated Groundwater Site - Former Hangars

100 Garden City Plaza

200 Garden City Plaza

300 Garden City Plaza

SVP-4

Roosevelt Field Shopping Center/ Former Airfield

EW-01S/I/D

Pembrook Recharge Basin

N-03934(GWP-10)

N-03935(GWP-11)

Village of Garden City Supply Wells

MW-3I MW-3S MW-3D

Nassau County Recharge Basin

Containment Area

Purex Site

N-08475

N-08474

Uniondale Supply Wells

Nassau County Recharge Basin

N-00082

N-00083

N-00081

N-07298

N-04425

N-00080

Village of Hempstead Supply Wells

Long Island, NY

Site Map Area

Legend

- Railroad
- Purex Site
- Purex Site Containment Area
- Former Hangars
- Former Boundary of Roosevelt Field Airfield
- Former Avis Headquarters Site
- Public Supply Well
- Monitoring Wells
- Existing Multi-port Well
- Public Supply Well
- Pasley Site

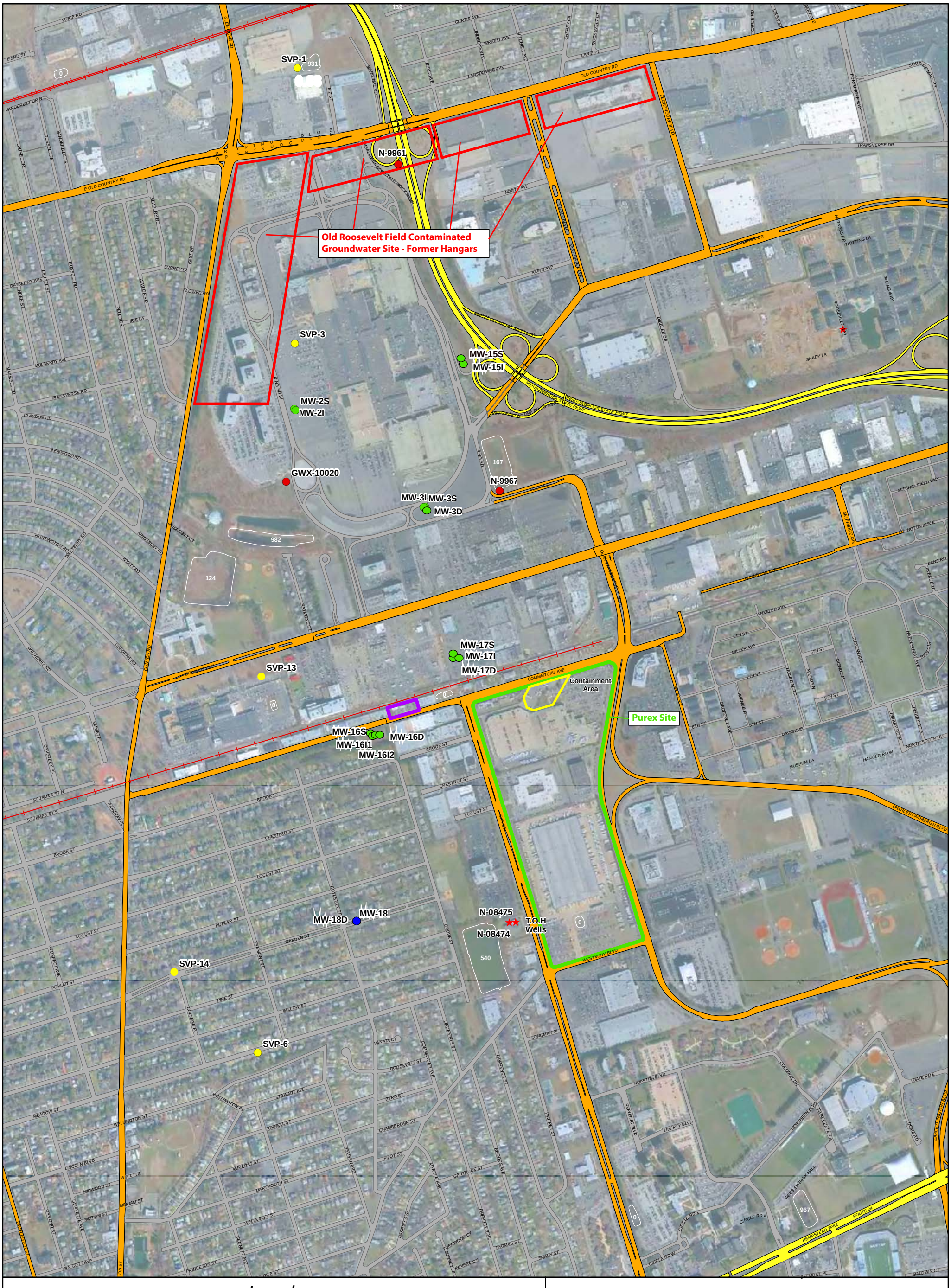
CDM Smith

Source: Nassau County Geographic Information System

N

0 80160 320 480 640 800 Feet

Figure 2-2
Site Map
Old Roosevelt Field
Contaminated Groundwater Area Site, Operable Unit 2
Garden City, Nassau County, New York



Legend

- Railroad
- Purex Site
- Purex Site Containment Area
- Pasley Site
- Monitoring Wells
- Existing Multi-port Well
- Existing Nassau County Well
- Newly Installed Monitoring Well (OU2)
- Public Supply Well

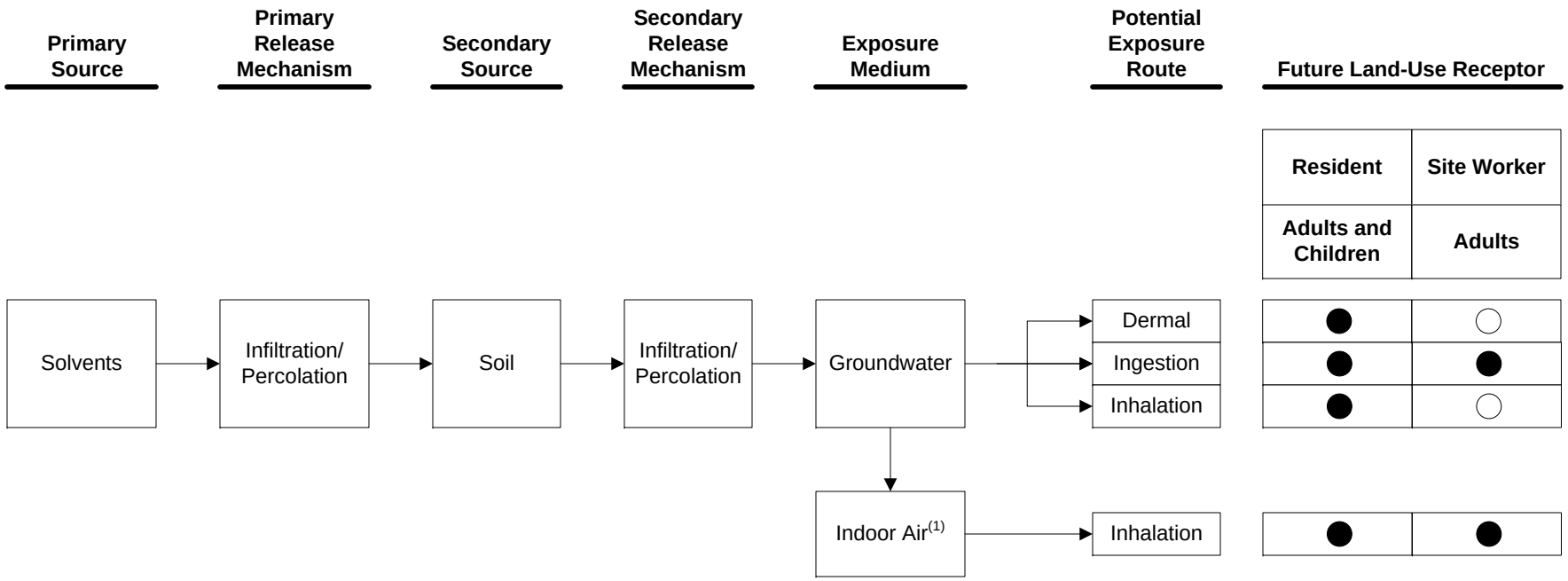
CDM Smith

Source: Nassau County Geographic Information System

N

0 80160 320 480 640 800 Feet

Figure 3-1
Monitoring Well Locations
Old Roosevelt Field
Contaminated Groundwater Area Site, Operable Unit 2
Garden City, Nassau County, New York



Legend:

● complete exposure pathway

○ Incomplete/insignificant exposure pathway

Note:

(1) Vapor intrusion screening is performed using the groundwater data.

CDM Smith

Figure 4-1
Conceptual Site Model
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, Nassau County, New York

Appendix A

Appendix A

List of Samples Evaluated in the Risk Assessment

Table A-1 Groundwater Sample List

TABLE A-1
GROUNDWATER SAMPLE LIST
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Location	Sample ID	Sample Depth (feet bgs)	Sample Date	Well Pair	Included in Risk Assessment?
Monitoring Wells					
MW-2S	MW-2S-2016	236 - 246	12/12/2016	MW-2S/MW-2I	Yes
MW-2I	MW-2I-2016	306 - 316	12/12/2016		
MW-3S	MW-3S-2016	234 - 344	12/12/2016	MW-3S/MW-3I/ MW-3D	Yes
MW-3I	MW-3I-2016	304 - 314	12/12/2016		
MW-3D	MW-3D-2016	490 - 500	12/9/2016		
MW-15S	MW-15S-2016	160 - 170	12/13/2016	MW-15S/MW-15I	Yes
MW-15I	MW-15I-2016	300 - 310	12/13/2016		
MW-16S	MW-16S-2016	125 - 135	12/13/2016	MW-16S/MW-16I1/ MW-16I2/MW-16D	Yes
MW-16I1	MW-16I1-2016	340 - 350	12/14/2016		
MW-16I2	MW-16I2-2016	365 - 375	12/14/2016		
MW-16D	MW-16D-2016	400 - 410	12/14/2016		
MW-17S	MW-17S-2016	85 - 95	12/13/2016	MW-17S/MW-17I/ MW-17D	Yes
MW-17I	MW-17I-2016	340 - 350	12/13/2016		
MW-17D	MW-17D-2016	430 - 440	12/13/2016		
MW-18I	MW-18I-2016	394 - 404	12/15/2016	MW-18I/MW-18D	Yes
MW-18D	MW-18D-2016	480 - 490	12/15/2016		
Multi-port Monitoring Wells					
SVP/GWM-1-1	SVP-1-1-2016	450	12/14/2016	SVP-1	No (upgradient)
SVP/GWM-1-5	SVP-1-5-2016	293	12/14/2016		
SVP/GWM-1-9	SVP-1-9-2016	103	12/14/2016		
SVP/GWM-3-1	SVP-3-1-2016	450	12/14/2016	SVP-3	Yes
SVP/GWM-3-3	SVP-3-3-2016	373	12/14/2016		
SVP/GWM-3-4	SVP-3-4-2016	293	12/14/2016		
SVP/GWM-3-5	SVP-3-5-2016	173	12/14/2016		
SVP/GWM-3-6	SVP-3-6-2016	103	12/14/2016		
SVP/GWM-6-1	SVP-6-1-2016	447	12/13/2016	SVP-6	Yes
SVP/GWM-6-3	SVP-6-3-2016	250	12/13/2016		
SVP/GWM-6-5	SVP-6-5-2016	105	12/13/2016		
SVP/GWM-13-3	SVP-13-3-2016	405	12/13/2016	SVP-13	Yes
SVP/GWM-13-5	SVP-13-5-2016	295	12/13/2016		
SVP/GWM-14-3	SVP-14-3-2016	410	12/13/2016	SVP-14	Yes
SVP/GWM-14-5	SVP-14-5-2016	300	12/13/2016		
SVP/GWM-14-9	SVP-14-9-2016	100	12/13/2016		
Supply Wells [(1)]					
GWX-10020	GWX-10020-2016	185 - 190	12/9/2016	GWX-10020	Yes
N-9967	N-9967-2016	48 - 54	12/14/2016	N-9967	Yes
N-8474	N-5-2016	485 - 556	12/14/2016	N-8474	No (tap water)
N-8475	N-6-2016	409 - 481	12/14/2016	N-8475	No (tap water)
N-9961	N-9961-2016	48 - 54	12/14/2016	N-9961	Yes
				Total Groundwater Data Points [(2)]	**13**

Notes:
ID = identification
(1) Supply wells sample results are not included in risk calculations except those used as monitoring wells since they are treated groundwater samples.
(2) Maximum detection from paired/multi-port monitoring wells samples were used in the exposure point concentration calculation.

Appendix B

Appendix B

RAGS D Tables for Reasonable Maximum Exposure Scenario

TABLE B-1
SELECTION OF EXPOSURE PATHWAYS
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor (Age)	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Groundwater	Groundwater	Resident	Adult and Child (birth to <6 yrs)	Dermal	Quant	Private wells could be installed in the future or if the municipalities removed the treatment systems or if those systems failed.
						Ingestion	Quant	Private wells could be installed in the future or if the municipalities removed the treatment systems or if those systems failed.
						Inhalation	Quant	Private wells could be installed in the future or if the municipalities removed the treatment systems or if those systems failed.
				Site Worker	Adult	Ingestion	Quant	Private wells could be installed in the future or if the municipalities removed the treatment systems or if those systems failed.
		Indoor Air	Indoor Air	Resident	Adult and Child (birth to <6 yrs)	Inhalation	Quant	Residential homes could be located on the site in the future and residents could be exposed via inhalation of vapors from subsurface intrusion. Groundwater concentrations are screened against the Vapor Intrusion Screening Levels in the risk assessment.
				Site Worker	Adult	Ingestion	Quant	Site workers could be exposed via inhalation of vapors from subsurface intrusion if private wells are installed. Groundwater concentrations are screened against the Vapor Intrusion Screening Levels in the risk assessment.

Note:
Quant = Quantitative risk analysis performed

TABLE B-2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Point	CAS No.	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Unit	Location of Maximum Concentration	Detection Frequency	Range of Reporting Limit	Concentration Used for Screening [1]	Background Value	Screening Toxicity Value (n/c) [2]	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Yes/No)	Rationale for Selection or Deletion [3]
Groundwater	**Volatile Organic Compounds**														
	71-55-6	1,1,1-Trichloroethane	0.67 J	18 J	µg/L	SVP/GWM-6	5 / 13	0.5 - 5	18	NA	800 n	NA	NA	No	BSL
	76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane	6	6.6	µg/L	SVP/GWM-3	3 / 13	0.5 - 5	6.6	NA	5500 n	NA	NA	No	BSL
	75-34-3	**1,1-Dichloroethane**	**0.86 J**	**24 J**	**µg/L**	**SVP/GWM-6**	**7 / 13**	**0.5 - 5**	**24**	**NA**	**2.8 c**	**NA**	**NA**	**Yes**	**ASL**
	75-35-4	**1,1-Dichloroethene**	**1.3 J**	**44 J+**	**µg/L**	**SVP/GWM-6**	**6 / 13**	**0.5 - 5**	**44**	**NA**	**28 n**	**NA**	**NA**	**Yes**	**ASL**
	107-06-2	1,2-Dichloroethane	0.14 J	0.14 J	µg/L	SVP/GWM-6	1 / 13	0.5 - 5	0.14	NA	0.17 c	NA	NA	No	BSL
	106-46-7	1,4-Dichlorobenzene	0.17 J	0.17 J	µg/L	MW-15	1 / 13	0.5 - 5	0.17	NA	0.48 c	NA	NA	No	BSL
	78-93-3	2-Butanone	3.8 J	3.8 J	µg/L	SVP/GWM-14	1 / 13	5 - 10	3.8	NA	560 n	NA	NA	No	BSL
	67-64-1	Acetone	4.6 J	17 J	µg/L	MW-3	2 / 13	5 - 10	17	NA	1400 n	NA	NA	No	BSL
	71-43-2	**Benzene**	**0.11 J**	**0.24 J**	**µg/L**	**SVP/GWM-6**	**4 / 13**	**0.5 - 5**	**0.24**	**NA**	**0.46 c**	**NA**	**NA**	**Yes**	**TOX**
	56-23-5	**Carbon Tetrachloride**	**0.16 J**	**0.49 J**	**µg/L**	**SVP/GWM-6**	**3 / 13**	**0.5 - 5**	**0.49**	**NA**	**0.46 c**	**NA**	**NA**	**Yes**	**ASL**
	67-66-3	**Chloroform**	**0.53 J**	**1**	**µg/L**	**MW-18**	**2 / 13**	**0.5 - 5**	**1**	**NA**	**0.22 c**	**NA**	**NA**	**Yes**	**ASL**
	156-59-2	**cis-1,2-Dichloroethene**	**1.7 J**	**14 J+**	**µg/L**	**SVP/GWM-6**	**6 / 13**	**0.5 - 5**	**14**	**NA**	**3.6 n**	**NA**	**NA**	**Yes**	**ASL**
	75-71-8	Dichlorodifluoromethane	0.5 J	9.4	µg/L	MW-2	2 / 13	0.5 - 5	9.4	NA	20 n	NA	NA	No	BSL
	100-41-4	**Ethylbenzene**	**1.5**	**2.8 J**	**µg/L**	**MW-3**	**2 / 13**	**0.5 - 5**	**2.8**	**NA**	**1.5 c**	**NA**	**NA**	**Yes**	**ASL**
	179601-23-1	m,p-Xylene	0.11 J	14 J	µg/L	MW-3	3 / 13	0.5 - 5	14	NA	19 n [4]	NA	NA	No	BSL
	1634-04-4	**Methyl Tert-Butyl Ether**	**0.59 J**	**30**	**µg/L**	**SVP/GWM-3**	**4 / 13**	**0.5 - 5**	**30**	**NA**	**14 c**	**NA**	**NA**	**Yes**	**ASL**
	95-47-6	o-Xylene	0.17 J	9.1 J	µg/L	MW-3	2 / 13	0.5 - 5	9.1	NA	19 n	NA	NA	No	BSL
	127-18-4	**Tetrachloroethene**	**0.59 J**	**600**	**µg/L**	**MW-16**	**9 / 13**	**0.5 - 50**	**600**	**NA**	**4.1 n**	**NA**	**NA**	**Yes**	**ASL**
	108-88-3	Toluene	0.09 J	0.38 J	µg/L	MW-3	3 / 13	0.5 - 5	0.38	NA	110 n	NA	NA	No	BSL
	156-60-5	trans-1,2-Dichloroethene	0.33 J	0.33 J	µg/L	SVP/GWM-6	1 / 13	0.5 - 5	0.33	NA	36 n	NA	NA	No	BSL
	79-01-6	**Trichloroethene**	**1.3 J**	**150**	**µg/L**	**SVP/GWM-13**	**10 / 13**	**0.5 - 20**	**150**	**NA**	**0.28 n**	**NA**	**NA**	**Yes**	**TOX**
	75-69-4	Trichlorofluoromethane	2	140	µg/L	SVP/GWM-3	3 / 13	0.5 - 25	140	NA	520 n	NA	NA	No	BSL
	75-01-4	**Vinyl Chloride**	**9.1 J**	**9.1 J**	**µg/L**	**SVP/GWM-6**	**1 / 13**	**0.5 - 5**	**9.1**	**NA**	**0.019 c**	**NA**	**NA**	**Yes**	**TOX**
	Inorganics														
	7429-90-5	Aluminum	340	980	µg/L	MW-17	2 / 2	20 - 20	980	NA	2000 n	NA	NA	No	BSL
	7440-38-2	**Arsenic**	**1.9**	**3.1**	**µg/L**	**MW-18**	**2 / 2**	**1 - 1**	**3.1**	**NA**	**0.052 c**	**NA**	**NA**	**Yes**	**TOX**
	7440-39-3	Barium	18	23	µg/L	MW-17	2 / 2	1 - 1	23	NA	380 n	NA	NA	No	BSL
	7440-70-2	Calcium	23000	41000	µg/L	MW-17	2 / 2	100 - 100	41000	NA	NA	NA	NA	No	NUT
	7440-47-3	**Chromium**	**3.2**	**8.9**	**µg/L**	**MW-17**	**2 / 2**	**1 - 1**	**8.9**	**NA**	**0.035 c [5]**	**NA**	**NA**	**Yes**	**ASL**
	7440-48-4	**Cobalt**	**6.9**	**6.9**	**µg/L**	**MW-17**	**1 / 2**	**1 - 1**	**6.9**	**NA**	**0.6 n**	**NA**	**NA**	**Yes**	**ASL**
	7440-50-8	Copper	2.5	8	µg/L	MW-17	2 / 2	1 - 1	8	NA	80 n	NA	NA	No	BSL
	7439-89-6	Iron	340	1100	µg/L	MW-17	2 / 2	20 - 20	1100	NA	1400 n	NA	NA	No	BSL
	7439-92-1	Lead	1.2	3.9	µg/L	MW-17	2 / 2	1 - 1	1.8	NA	15 [6]	NA	NA	No	BSL
	7439-95-4	Magnesium	1500	2800	µg/L	MW-17	2 / 2	100 - 100	2800	NA	NA	NA	NA	No	NUT

TABLE B-2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Point	CAS No.	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Unit	Location of Maximum Concentration	Detection Frequency	Range of Reporting Limit	Concentration Used for Screening [1]	Background Value	Screening Toxicity Value (n/c) [2]	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag (Yes/No)	Rationale for Selection or Deletion [3]
Groundwater (continued)	7439-96-5	Manganese	8.9	19	µg/L	MW-17	2 / 2	1 - 1	19	NA	43 n	NA	NA	No	BSL
	7440-02-0	Nickel	2.9	7.2	µg/L	MW-17	2 / 2	1 - 1	7.2	NA	39 n [7]	NA	NA	No	BSL
	7440-09-7	Potassium	4000	28000	µg/L	MW-17	2 / 2	100 - 100	28000	NA	NA	NA	NA	No	NUT
	7440-23-5	Sodium	36000	42000	µg/L	MW-17	2 / 2	100 - 100	42000	NA	NA	NA	NA	No	NUT
	7440-62-2	**Vanadium**	**6.5**	**9.1**	**µg/L**	**MW-18**	**2 / 2**	**1 - 1**	**9.1**	**NA**	**8.6 n [8]**	**NA**	**NA**	**Yes**	**ASL**
	7440-66-6	**Zinc**	**910**	**950**	**µg/L**	**MW-18**	**2 / 2**	**2 - 2**	**950**	**NA**	**600 n**	**NA**	**NA**	**Yes**	**ASL**

[1] Maximum detected concentration used for screening

[2] Screened against Regional Screening Levels, May 2016, for tap water, adjusted to a cancer risk of 1×10^{-6} and hazard quotient of 0.1. http://www.epa.gov/region09/waste/sfund/prg/index.html

[3] Rationale Codes:

Selection Reason: ASL = above screening level
TOX = Group A carcinogen

Deletion Reason: BSL = below screening level
NUT = essential nutrient

[4] screening value for m-xylene

[5] screening value for chromium VI

[6] Federal Action Level

[7] screening value for nickel soluble salts

[8] screening value for vanadium and compounds

NA = not available

n = screening toxicity value based on noncancer effects

c = screening toxicity value based on cancer effects

COPC = chemical of potential concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/To Be Considered

J = qualifier for estimated value

J+ = qualifier for biased high estimated value

µg/L = micrograms per liter

TABLE B-3
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Scenario Timeframe	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Point	Chemical of Potential Concern	Unit	Mean Concentration (1)	Upper Confidence Limit (1)	Maximum Concentration (Qualifier)	Exposure Point Concentration (2)			
						Value	Unit	Statistic	Rationale (3)
Groundwater	**Volatile Organic Compounds**								
	1,1-Dichloroethane	µg/L	4.0	11.8	24 J	11.8	µg/L	UCL-NP	95% KM (Chebyshev) UCL
	1,1-Dichloroethene	µg/L	7.8	14.6	44 J+	14.6	µg/L	UCL-NP	95% KM (t) UCL
	Benzene	µg/L	0.17	0.23	0.24 J	0.23	µg/L	UCL-NP	95% KM (t) UCL
	Carbon Tetrachloride	µg/L	NA	NA	0.49 J	0.49	µg/L	Max	<4 detected values
	Chloroform	µg/L	NA	NA	1	1	µg/L	Max	<4 detected values
	cis-1,2-Dichloroethene	µg/L	4.2	6.5	14 J+	6.5	µg/L	UCL-NP	95% KM (t) UCL
	Ethylbenzene	µg/L	NA	NA	2.8 J	2.8	µg/L	Max	<4 detected values
	Methyl Tert-Butyl Ether	µg/L	4.9	11	30	11	µg/L	UCL-NP	95% KM (t) UCL
	Tetrachloroethene	µg/L	106	407	600	407	µg/L	UCL-NP	95% KM Bootstrap t UCL
	Trichloroethene	µg/L	32.1	125	150	125	µg/L	UCL-NP	97.5% KM (Chebyshev) UCL
	Vinyl Chloride	µg/L	NA	NA	9.1 J	9.1	µg/L	Max	<4 detected values
	Inorganics								
	Arsenic	µg/L	NA	NA	3.1	3.1	µg/L	Max	<5 samples
	Chromium	µg/L	NA	NA	8.9	8.9	µg/L	Max	<5 samples
	Cobalt	µg/L	NA	NA	6.9	6.9	µg/L	Max	<5 samples
	Vanadium	µg/L	NA	NA	9.1	9	µg/L	Max	<5 samples
	Zinc	µg/L	NA	NA	950	950	µg/L	Max	<5 samples

µg/L = microgram per liter
NA = not applicable
J = qualifier for estimated value
J+ = qualifier for biased high estimated value
KM = Kaplan-Meier

Notes:
(1) Mean and upper confidence limit (UCL) concentrations are calculated using ProUCL version 5.1 for chemicals with at least 5 samples in a dataset and 4 detected values.
(2) Exposure point concentration is lower of maximum concentration and UCL.
(3) Rationale: UCL-NP = upper confidence limit of mean of non-parametric distribution
Max = maximum detected concentration

TABLE B-4.1a
VALUES USED FOR DAILY INTAKE CALCULATIONS FOR GROUNDWATER EXPOSURE PATHWAYS
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Unit	RME		CTE	
							Value	Rationale/ Reference	Value	Rationale/ Reference
Ingestion	Worker	Adult	Tap Water	CW	Chemical Concentration in Water	µg/L	chemical specific	Table B-3	chemical specific	Table B-3
				CF1	Conversion Factor 1	mg/µg	0.001	--	0.001	--
				IR-W	Ingestion Rate of Water	L/day	2.5	EPA 2014	1	EPA 2011[1]
				EF	Exposure Frequency	days/year	250	EPA 2014	219	EPA 2004
				ED	Exposure Duration	years	25	EPA 2014	9	EPA 2004
				BW	Body Weight	kg	80	EPA 2014	80	EPA 2014
				AT-C	Averaging Time (Cancer)	days	25,550	EPA 2014	25,550	EPA 2014
				AT-N	Averaging Time (Noncancer)	days	9,125	EPA 1989	3,285	EPA 1989
	Resident	Adult and Child (birth to <6 yrs)	Tap Water	CW	Chemical Concentration in Water	µg/L	chemical specific	Table B-3	chemical specific	Table B-3
				CF1	Conversion Factor 1	mg/µg	0.001	--	0.001	--
				$IR\text{-}W_a$	Ingestion Rate of Water - adult	L/day	2.5	EPA 2014	1	EPA 2011[1]
				$IR\text{-}W_c$	Ingestion Rate of Water - child	L/day	0.78	EPA 2014	0.39	EPA 2011[2]
				BW_a	Body Weight - adult	kg	80	EPA 2014	80	EPA 2014
				BW_c	Body Weight - child	kg	15	EPA 2014	15	EPA 2014
				ED_a	Exposure Duration - adult	years	20	EPA 2014	3	EPA 2004
				ED_c	Exposure Duration - child	years	6	EPA 2014	6	EPA 2004
				EF	Exposure Frequency	days/year	350	EPA 2014	350	EPA 2014
				AT-C	Averaging Time (Cancer)	days	25,550	EPA 2014	25,550	EPA 2014
				$AT\text{-}N_c$	Averaging Time (Noncancer) - child	days	2,190	EPA 1989	2,190	EPA 1989
Dermal Contact	Resident	Adult Child (birth to <6 yrs)	Tap Water (Showering and Bathing)	CW	Chemical Concentration in Water	µg/L	chemical specific	Table B-3	chemical specific	Table B-3
				SA_a	Skin Surface Area Available for Contact - adult	cm^2/day	20,900	EPA 2014	20,900	EPA 2014
				SA_c	Skin Surface Area Available for Contact - child	cm^2/day	6,378	EPA 2014	6,378	EPA 2014
				$DA_{event\text{-}a}$	Absorbed Dose - adult	mg/cm^2	chemical specific	Table B-4.2	chemical specific	Table B-4.2
				$DA_{event\text{-}c}$	Absorbed Dose - child	mg/cm^2	chemical specific	Table B-4.2	chemical specific	Table B-4.2
				ET_a	Exposure Time - adult	hr/day	0.71	EPA 2014	0.36	EPA 2011[3]
				ET_c	Exposure Time - child	hr/day	0.54	EPA 2014	0.38	EPA 2011[4]
				EF	Exposure Frequency	days/year	350	EPA 2014	350	EPA 2014
				ED_a	Exposure Duration - adult	years	20	EPA 2014	3	EPA 2004
				ED_c	Exposure Duration - child	years	6	EPA 2014	6	EPA 2004
				BW_a	Body Weight - adult	kg	80	EPA 2014	80	EPA 2014
				BW_c	Body Weight - child	kg	15	EPA 2014	15	EPA 2014
				AT-C	Averaging Time (Cancer)	days	25,550	EPA 2014	25,550	EPA 2014
				$AT\text{-}N_c$	Averaging Time (Noncancer) - child	days	2,190	EPA 1989	2,190	EPA 1989

TABLE B-4.1a
VALUES USED FOR DAILY INTAKE CALCULATIONS FOR GROUNDWATER EXPOSURE PATHWAYS
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Unit	RME		CTE	
							Value	Rationale/ Reference	Value	Rationale/ Reference
Inhalation	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	µg/L	chemical specific	Table B-3	chemical specific	Table B-3
		Child	(Showering	CA_a	Chemical Concentration in Air - adult	$\mu g/m^3$	chemical specific	Table D-3	chemical specific	Table D-3
		(birth to <6 yrs)	and Bathing)	CA_c	Chemical Concentration in Air - child	$\mu g/m^3$	chemical specific	Table D-4	chemical specific	Table D-4
				CF1	Conversion Factor 1	mg/µg	0.001	-	0.001	-
				ET_a	Exposure Time - adult	hr/day	0.71	EPA 2014	0.36	EPA 2011[3]
				ET_c	Exposure Time - child	hr/day	0.54	EPA 2014	0.38	EPA 2011[4]
				EF	Exposure Frequency	days/yr	350	EPA 2014	350	EPA 2014
				ED_a	Exposure Duration - adult	years	20	EPA 2014	3	EPA 2004
				ED_c	Exposure Furation - child	years	6	EPA 2014	6	EPA 2004
				AT-C	Averaging Time (Cancer)	hrs	613,200	EPA 2014	613,200	EPA 2014
				$AT\text{-}N_c$	Averaging Time (Noncancer) - child	hrs	52,560	EPA 1989	52,560	EPA 1989

RME = Reasonable Maximum Exposure; CTE = Central Tendency Exposure

Notes:
[1] based on mean of consumer-only ingestion of drinking water (≥21 years old [Table 3-33])
[2] based on the weighted average of mean of consumer-only ingestion of drinking water (birth to <3 years old [Table 3-15] and 3 to <6 years old [Table 3-33])
[3] based on the weighted average of adult (21 to 78) mean time spent bathing/showering in a day (Table 16-31) divided by the mean number of baths/showers taken in a day (Table 16-30)
[4] based on the weighted average of mean time spent bathing (birth to <6 years) (Table 16-1)

Sources:
EPA 1989. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002
EPA 2004. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment Final. EPA/540/R/99/005
EPA 2011. Exposure Factors Handbook: 2011 Edition. EPA/600/R-090/052F. September.
EPA 2014. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factor. OSWER Directive 9200.1-120. February 6.

TABLE B-4.1b
EQUATIONS USED FOR DAILY INTAKE CALCULATIONS FOR GROUNDWATER EXPOSURE PATHWAYS
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

For site workers

Ingestion Pathway

$$DI = \frac{CW \times CF1 \times IR\text{-}W \times EF \times ED}{BW \times AT}$$

For residents

Ingestion Pathway

Carcinogenic

$$DI = \frac{CW \times CF1 \times IR\text{-}W_a \times ED_a \times EF}{AT\text{-}C \times BW_a} + \frac{CW \times CF1 \times IR\text{-}W_c \times ED_c \times EF}{AT\text{-}C \times BW_c}$$

Trichloroethene - See Table B-7.0

Vinyl Chloride

$$DI = \frac{CW \times CF1 \times \{(IR\text{-}W_a \times ED_a/BW_a) + (IR\text{-}W_c \times ED_c/BW_c)\} \times EF}{AT\text{-}C} + CW \times CF1 \times IR\text{-}W_c/BW_c$$

Non-carcinogenic - child

$$DI = \frac{CW \times CF1 \times IR\text{-}W_c \times ED_c \times EF}{AT\text{-}N_c \times BW_c}$$

Dermal Contact Pathway

Carcinogenic

$$DAD = \frac{SA_a \times DA_{event\text{-}a} \times ED_a \times EF}{AT\text{-}C \times BW_a} + \frac{SA_c \times DA_{event\text{-}c} \times ED_c \times EF}{AT\text{-}C \times BW_c}$$

Trichloroethene - See Table B-7.0

Vinyl Chloride

$$DAD = \frac{\{(SA_a \times DA_{event\text{-}a} \times ED_a/BW_a) + (SA_c \times DA_{event\text{-}c} \times ED_c/BW_c)\} \times EF}{AT\text{-}C} + SA_c \times DA_{event\text{-}c}/BW_c$$

Non-carcinogenic - child

$$DAD = \frac{SA_c \times DA_{event\text{-}c} \times ED_c \times EF}{AT\text{-}N_c \times BW_c}$$

Inhalation Pathway

Carcinogenic

$$EC = CF1 \times CA_a \times ET_a \times ED_a \times EF / AT\text{-}C + CF1 \times CA_c \times ET_c \times ED_c \times EF / AT\text{-}C$$

Trichloroethene - See Table B-7.0

Vinyl Chloride

$$EC = CF1 \times \{(CA_a \times ET_a \times ED_a) + (CA_c \times ET_c \times ED_c)\} \times EF/AT\text{-}C + (CF1 \times CA_c)$$

Non-carcinogenic - child

$$EC = CF1 \times CA_c \times ET_c \times ED_c \times EF / AT\text{-}N_c$$

TABLE B-4.1b
EQUATIONS USED FOR DAILY INTAKE CALCULATIONS FOR GROUNDWATER EXPOSURE PATHWAYS
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Sources:

EPA 1989. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA 2004. Risk Assessment Guidance for Superfund. Vol. 1: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment Final. EPA/540/R/99/005.

DI	Daily intake	mg/kg-day
DAD	Dermally Absorbed Dose	mg/kg-day
CW	Chemical Concentration in Water	µg/L
CF1	Conversion Factor 1	mg/µg
$IR\text{-}W_a$	Ingestion Rate of Water - adult	L/day
$IR\text{-}W_c$	Ingestion Rate of Water - child	L/day
SA_a	Skin Surface Area Available for Contact - adult	cm^2/day
SA_c	Skin Surface Area Available for Contact - child	cm^2/day
$DA_{event\text{-}a}$	Absorbed Dose - adult (Table B-4.2)	mg/cm^2
$DA_{event\text{-}c}$	Absorbed Dose - child (Table B-4.2)	mg/cm^2
EC	Exposure Concentration	mg/m^3
CA_a	Chemical Concentration in Air - adult (Table D-3)	$µg/m^3$
CA_c	Chemical Concentration in Air - child (Table D-4)	$µg/m^3$
ET_a	Exposure Time - adult	hrs/day
ET_c	Exposure Time - child	hrs/day
EF	Exposure Frequency	days/year
ED_a	Exposure Duration - adult	years
ED_c	Exposure Duration - child	years
BW_a	Body Weight - adult	kg
BW_c	Body Weight - child	kg
AT-C	Averaging Time (Cancer) AT-C = 70 years x 365 days /year	days or hrs
$AT\text{-}N_a$	Averaging Time (Noncancer) - adult	days or hrs
$AT\text{-}N_c$	Averaging Time (Noncancer) - child	days or hrs
	AT-N = ED x 365 days/year AT-N = ED x 365 days/year x 24 hr/day -- inhalation pathway	

TABLE B-4.2
CHEMICAL-SPECIFIC INFORMATION USED FOR DAILY INTAKE CALCULATIONS
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Chemical	Permeability Coefficient [1] (cm/hr)	Fraction absorbed water[1] Unitless	Lag time per event[1] (hr/event)	Time to reach steady state[1] (hr)	B[1] (Unitless)	DA_{event}[2] Worker (mg/cm^2)	DA_{event}[2] RME (mg/cm^2)	DA_{event}[2] CTE (mg/cm^2)	Henry's Law Constant[3] Unitless	Diffusivity in Air[3] (cm^2/s)	Diffusivity in Water[3] (cm^2/s)	Fraction Volatilized[5] Unitless
Volatile Organic Compounds												
1,1-Dichloroethane	6.7E-03	1.0E+00	3.8E-01	9.2E-01	0.0E+00	1.0E-07	1.1E-07	8.2E-08	2.3E-01	8.4E-02	1.1E-05	5.4E-01
1,1-Dichloroethene	1.2E-02	1.0E+00	3.7E-01	8.9E-01	0.0E+00	2.2E-07	2.4E-07	1.8E-07	1.1E+00	8.6E-02	1.1E-05	5.5E-01
Benzene	1.5E-02	1.0E+00	2.9E-01	7.0E-01	1.0E-01	3.9E-09	4.2E-09	3.2E-09	2.3E-01	9.0E-02	1.0E-05	5.3E-01
Carbon Tetrachloride	1.6E-02	1.0E+00	7.8E-01	1.9E+00	1.0E-01	1.5E-08	1.6E-08	1.2E-08	1.1E+00	5.7E-02	9.8E-06	5.1E-01
Chloroform	6.8E-03	1.0E+00	5.0E-01	1.2E+00	0.0E+00	1.0E-08	1.1E-08	8.1E-09	1.5E-01	7.7E-02	1.1E-05	5.5E-01
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	1.7E-01	8.8E-02	1.1E-05	5.6E-01
Ethylbenzene	4.9E-02	1.0E+00	4.2E-01	1.0E+00	2.0E-01	1.9E-07	2.0E-07	1.5E-07	3.2E-01	6.8E-02	8.5E-06	4.6E-01
Methyl Tert-Butyl Ether	NA	NA	NA	NA	NA	NA	NA	NA	2.4E-02	7.5E-02	8.6E-06	4.7E-01
Tetrachloroethene	3.3E-02	1.0E+00	9.1E-01	2.2E+00	2.0E-01	2.7E-05	2.9E-05	2.2E-05	7.2E-01	5.0E-02	9.5E-06	5.0E-01
Trichloroethene	1.2E-02	1.0E+00	5.8E-01	1.4E+00	1.0E-01	2.4E-06	2.6E-06	1.9E-06	4.0E-01	6.9E-02	1.0E-05	5.3E-01
Vinyl Chloride	5.6E-03	1.0E+00	2.4E-01	5.7E-01	0.0E+00	5.4E-08	5.9E-08	4.2E-08	1.1E+00	1.1E-01	1.2E-05	5.9E-01
Inorganics												
Arsenic	1.0E-03	NA	NA	NA	NA	1.8E-09	2.1E-09	1.2E-09	NA	NA	NA	NA
Chromium	1.0E-03	NA	NA	NA	NA	5.2E-09	6.0E-09	3.3E-09	NA	NA	NA	NA
Cobalt	4.0E-04	NA	NA	NA	NA	1.6E-09	1.9E-09	1.0E-09	NA	NA	NA	NA
Vanadium	1.0E-03	NA	NA	NA	NA	5.3E-09	6.1E-09	3.4E-09	NA	NA	NA	NA
Zinc	6.0E-04	NA	NA	NA	NA	3.3E-07	3.8E-07	2.1E-07	NA	NA	NA	NA

NA - Not applicable
RME - reasonable maximum exposure
CTE - central tendency exposure

Notes:

[1] Source: EPA 2004. Risk Assessment Guidance for Superfund. Part E.

[2] Absorbed dose per event is calculated using Equations 3.2, 3.3, and 3.4 from EPA 2004 (p.3-4)

for organics:

$$\text{If } t_{event} \le t^*, DA_{event} = 2FA \times K_p \times C_W \sqrt{\frac{6\tau_{event} \times t_{event}}{\pi}}$$

$$\text{If } t_{event} > t^*, DA_{event} = FA \times K_p \times C_W \left[\frac{t_{event}}{1+B} + 2\tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

for inorganics:

$$DA_{event} = K_p \times C_W \times t_{event}$$

Where:

DA_{event} = absorbed dose per event, mg/cm^2
τ_{event} = lag time per event, hr
t* = time to reach steady-state, hr
FA = fraction absorbed water
t_{event} = event duration, hr
B = dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis

[5] Estimated for volatile chemicals using Equation 5 from Schaum et al (1994) (p. 308), with radon as the reference chemical (j):

$$f_i = f_j \times \frac{\left(2.5/{D_W}^{0.67} + RT/{D_a}^{0.67}H\right)_j}{\left(2.5/{D_W}^{0.67} + RT/{D_a}^{0.67}H\right)_i}$$

Where:

f_i = volatilization fraction for chemical i
D_w = diffusion coefficient in water, m^2/s
R = gas constant, atm-m^3/mol-K = 8.21 x 10^{-5}
f_j = volatilization fraction for chemical j = Radon
D_a for Radon = 2.0 x 10^{-5}
H = Henry's law constant, atm-m^3/mol
D_a = diffusion coefficient in air, m^2/s
D_w for Radon = 1.4 x 10^{-9}
T = temperature, K = 293

TABLE B-5.1

NONCANCER TOXICITY DATA - ORAL/DERMAL

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal [1]	Absorbed RfD for Dermal [2]		Primary Target Organ	Combined Uncertainty/ Modifying Factor	Source	Date [3]
		Value	Unit		Value	Unit				
Volatile Organic Compounds										
1,1-Dichloroethane	Chronic	2.0E-01	mg/kg-day	1	2.0E-01	mg/kg-day	Kidney	3,000	PPRTV	9/27/2006
1,1-Dichloroethene	Chronic	5.0E-02	mg/kg-day	1	5.0E-02	mg/kg-day	Liver	100	IRIS	3/14/2017
Benzene	Chronic	4.0E-03	mg/kg-day	1	4.0E-03	mg/kg-day	Blood	300	IRIS	3/14/2017
Carbon Tetrachloride	Chronic	4.0E-03	mg/kg-day	1	4.0E-03	mg/kg-day	Liver/Kidney	1,000	IRIS	3/14/2017
Chloroform	Chronic	1.0E-02	mg/kg-day	1	1.0E-02	mg/kg-day	Liver	100	IRIS	3/14/2017
cis-1,2-Dichloroethene	Chronic	2.0E-03	mg/kg-day	1	2.0E-03	mg/kg-day	Kidney	3,000	IRIS	3/14/2017
Ethylbenzene	Chronic	1.0E-01	mg/kg-day	1	1.0E-01	mg/kg-day	Liver/Kidney	1,000	IRIS	3/14/2017
Methyl Tert-Butyl Ether	Chronic	NA	NA	1	NA	NA	NA	NA	NA	NA
Tetrachloroethene	Chronic	6.0E-03	mg/kg-day	1	6.0E-03	mg/kg-day	Nervous System/Liver/Kidney	1,000	IRIS	3/14/2017
Trichloroethene	Chronic	5.0E-04	mg/kg-day	1	5.0E-04	mg/kg-day	Heart/ Immune System/ Developmental/Kidney	10 to 1,000	IRIS	3/14/2017
Vinyl Chloride	Chronic	3.0E-03	mg/kg-day	1	3.0E-03	mg/kg-day	Liver	30	IRIS	3/14/2017
Inorganics										
Arsenic	Chronic	3.0E-04	mg/kg-day	1	3.0E-04	mg/kg-day	Skin	3	IRIS	3/14/2017
Chromium[4]	Chronic	3.0E-03	mg/kg-day	0.025	7.5E-05	mg/kg-day	None reported	300	IRIS	3/14/2017
Cobalt	Chronic	3.0E-04	mg/kg-day	1	3.0E-04	mg/kg-day	Thyroid	3,000	PPRTV	8/25/2008
Vanadium[5]	Chronic	9.0E-03	mg/kg-day	0.026	2.3E-04	mg/kg-day	Hair	100	IRIS	3/14/2017
Zinc	Chronic	3.0E-01	mg/kg-day	1	3.0E-01	mg/kg-day	Developmental	3	IRIS	3/14/2017

[1] Oral Absorption Efficiency for Dermal from Regional Screening Levels, May 2016
http://www.epa.gov/region09/waste/sfund/prg/index.html

[2] Adjusted RfD for Dermal = Oral RfD x Oral Absorption Efficiency for Dermal.

[3] Date shown for IRIS is the date IRIS was searched. http://www.epa.gov/iris/
Date shown for other sources is the publication date.

[4] based on chromium (VI)

[5] based on vanadium pentoxide

Definition:
IRIS = Integrated Risk Information System
mg/kg-day = milligram per kilogram per day
PPRTV = Provisional Peer Reviewed Toxicity Value
RfD = reference dose

TABLE B-5.2
NONCANCER TOXICITY DATA - INHALATION
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Chemical of Potential Concern	Inhalation RfC		Primary Target Organ	Combined Uncertainty/ Modifying Factor	RfC Target Organ	
	Value	Unit			Source	Date [1]
Volatile Organic Compounds						
1,1-Dichloroethane	NA	NA	NA	NA	NA	NA
1,1-Dichloroethene	2.0E-01	mg/m^3	Liver	30	IRIS	3/14/2017
Benzene	3.0E-02	mg/m^3	Blood	300	IRIS	3/14/2017
Carbon Tetrachloride	1.0E-01	mg/m^3	Liver	100	IRIS	3/14/2017
Chloroform	3.0E-01	mg/m^3	Alimentary System/Kidney/Developmental	300	Cal/EPA	2/1/2012
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA
Ethylbenzene	1.0E+00	mg/m^3	Developmental	300	IRIS	3/14/2017
Methyl Tert-Butyl Ether	3.0E+00	mg/m^3	Liver/Kidney	100	IRIS	3/14/2017
Tetrachloroethene	4.0E-02	mg/m^3	CNS/Liver/Kidney	1,000	IRIS	3/14/2017
Trichloroethene	2.0E-03	mg/m^3	Heart/Immune System/Liver	10 to 100	IRIS	3/14/2017
Vinyl Chloride	1.0E-01	mg/m^3	Liver	30	IRIS	3/14/2017
Inorganics						
Arsenic	1.5E-05	mg/m^3	Developmental/Cardiovascular System/ Nervous System/Lung/Skin	30	Cal/EPA	2/1/2012
Chromium[2]	8.0E-06	mg/m^3	Lung	300	IRIS	3/14/2017
Cobalt	6.0E-06	mg/m^3	Respiratory System/Lung	300	PPRTV	8/25/2008
Vanadium[3]	7.0E-06	mg/m^3	Respiratory System	300	PPRTV	4/30/2008
Zinc	NA	NA	NA	NA	NA	NA

[1] Date shown for IRIS is the date IRIS was searched. http://www.epa.gov/iris/
Date shown for other sources is the publication date.

[2] based on chromic acid mists and dissolved chromium (VI) aerosols

[3] based on vanadium pentoxide

Definition:
Cal/EPA = California Environmental Protection Agency
CNS = central nervous system
IRIS = Integrated Risk Information System
mg/m^3 = milligram per cubic meter
PPRTV = Provisional Peer Reviewed Toxicity Value
RfC = reference concentration

TABLE B-6.1

CANCER TOXICITY DATA - ORAL/DERMAL

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Chemical of Potential Concern	Oral Slope Factor		Oral Absorption Efficiency for Dermal [1]	Absorbed Slope Factor for Dermal [2]		Mutagen [3]	Weight of Evidence/ Cancer Guideline Description	Source	Date [4]
	Value	Unit		Value	Unit				
Volatile Organic Compounds									
1,1-Dichloroethane	5.7E-03	$(mg/kg\text{-}day)^{-1}$	1	5.7E-03	$(mg/kg\text{-}day)^{-1}$	--	C	Cal/EPA	6/1/2009
1,1-Dichloroethene	NA	NA	1	NA	NA	--	C	IRIS	3/14/2017
Benzene	5.5E-02	$(mg/kg\text{-}day)^{-1}$	1	5.5E-02	$(mg/kg\text{-}day)^{-1}$	--	A	IRIS	3/14/2017
Carbon Tetrachloride	7.0E-02	$(mg/kg\text{-}day)^{-1}$	1	7.0E-02	$(mg/kg\text{-}day)^{-1}$	--	likely to be carcinogenic to humans	IRIS	3/14/2017
Chloroform	3.1E-02	$(mg/kg\text{-}day)^{-1}$	1	3.1E-02	$(mg/kg\text{-}day)^{-1}$	--	B2	Cal/EPA	6/1/2009
cis-1,2-Dichloroethene	NA	NA	1	NA	NA	--	inadequate information to assess the carcinogenic potential	IRIS	3/14/2017
Ethylbenzene	1.1E-02	$(mg/kg\text{-}day)^{-1}$	1	1.1E-02	$(mg/kg\text{-}day)^{-1}$	--	D	Cal/EPA	6/1/2009
Methyl Tert-Butyl Ether	1.8E-03	$(mg/kg\text{-}day)^{-1}$	1	1.8E-03	$(mg/kg\text{-}day)^{-1}$	--	3	Cal/EPA	6/1/2009
Tetrachloroethene	2.1E-03	$(mg/kg\text{-}day)^{-1}$	1	2.1E-03	$(mg/kg\text{-}day)^{-1}$	--	likely to be carcinogenic to humans	IRIS	3/14/2017
Trichloroethene[5]	4.6E-02	$(mg/kg\text{-}day)^{-1}$	1	4.6E-02	$(mg/kg\text{-}day)^{-1}$	M	carcinogenic to humans	IRIS	3/14/2017
Vinyl Chloride[6]	7.2E-01	$(mg/kg\text{-}day)^{-1}$	1	7.2E-01	$(mg/kg\text{-}day)^{-1}$	M	A	IRIS	3/14/2017
Inorganics									
Arsenic	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1	1.5E+00	$(mg/kg\text{-}day)^{-1}$	--	A	IRIS	3/14/2017
Chromium[7]	5.0E-01	$(mg/kg\text{-}day)^{-1}$	0.025	5.0E-01	$(mg/kg\text{-}day)^{-1}$	--	likely to be carcinogenic to humans	NJDEP	4/8/2009
Cobalt	NA	NA	1	NA	NA	--	NA	NA	NA
Vanadium	NA	NA	0.026	NA	NA	--	inadequate information to assess the carcinogenic potential	PPRTV	9/30/2009
Zinc	NA	NA	1	NA	NA	--	D	IRIS	3/14/2017

[1] Oral Absorption Efficiency for Dermal from Regional Screening Levels, May 2016
http://www.epa.gov/region09/waste/sfund/prg/index.html

[2] Oral slope factor (SF) for Dermal = Oral SF

[3] Identified as a mutagen on the Regional Screening Level Table, May 2016

[4] Date shown for IRIS is the date IRIS was searched. http://www.epa.gov/iris/
Date shown for other sources is the publication date.

[5] Trichloroethene is considered carcinogenic by a mutagenic mode of action for induction of kidney tumors.
The adult-based oral SF for kidney cancer is 9.3×10^{-3} per mg/kg/day

[6] Oral SF listed is based on continuous lifetime exposure during adulthood.
The oral SF for the continuous lifetime exposure from birth is 1.4 per mg/kg/day.

[7] based on chromium (VI)

EPA Weight of Evidence (EPA 1986, EPA 1996):

A - Human Carcinogen

B1 - Probable human carcinogen
indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as human carcinogen

Definition:

Cal/EPA = California Environmental Protection Agency

IRIS = Integrated Risk Information System

mg/kg-day = milligram per kilogram per day

NA = not available

NJDEP = New Jersey Department of Environmental Protection

PPRTV = Provisional Peer Reviewed Toxicity Value

EPA Weight of Evidence Narrative (EPA 2005):

Carcinogenic to human

Likely to be carcinogenic to humans

Suggestive evidence of carcinogenic potential

Inadequate information to assess carcinogenic potential

Not likely to be carcinogenic to humans

IARC Classification:

3 - Not classifiable

TABLE B-6.2
CANCER TOXICITY DATA - INHALATION
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Chemical of Potential Concern	Inhalation Unit Risk		Mutagen [1]	Weight of Evidence/ Cancer Guideline Description	Inhalation Unit Risk	
	Value	Unit			Source	Date [2]
Volatile Organic Compounds						
1,1-Dichloroethane	1.6E-06	$(\mu g/m^3)^{-1}$	--	C	Cal/EPA	6/1/2009
1,1-Dichloroethene	NA	NA	--	C	IRIS	3/14/2017
Benzene	7.8E-06	$(\mu g/m^3)^{-1}$	--	A	IRIS	3/14/2017
Carbon Tetrachloride	6.0E-06	$(\mu g/m^3)^{-1}$	--	likely to be carcinogenic to humans	IRIS	3/14/2017
Chloroform	2.3E-05	$(\mu g/m^3)^{-1}$	--	B2	IRIS	3/14/2017
cis-1,2-Dichloroethene	NA	NA	--	inadequate information to assess the carcinogenic potential	IRIS	3/14/2017
Ethylbenzene	2.5E-06	$(\mu g/m^3)^{-1}$	--	D	Cal/EPA	6/1/2009
Methyl Tert-Butyl Ether	2.6E-07	$(\mu g/m^3)^{-1}$	--	3	Cal/EPA	6/1/2009
Tetrachloroethene	2.6E-07	$(\mu g/m^3)^{-1}$	--	likely to be carcinogenic to humans	IRIS	3/14/2017
Trichloroethene[3]	4.1E-06	$(\mu g/m^3)^{-1}$	M	carcinogenic to humans	IRIS	3/14/2017
Vinyl Chloride[4]	4.4E-06	$(\mu g/m^3)^{-1}$	M	A	IRIS	3/14/2017
Inorganics						
Arsenic	4.3E-03	$(\mu g/m^3)^{-1}$	--	A	IRIS	3/14/2017
Chromium[5]	1.2E-02	$(\mu g/m^3)^{-1}$	--	A	IRIS	3/14/2017
Cobalt	9.0E-03	$(\mu g/m^3)^{-1}$	--	likely to be carcinogenic to humans	PPRTV	8/25/2008
Vanadium[6]	8.3E-03	$(\mu g/m^3)^{-1}$	--	suggestive evidence of carcinogenic potential	PPRTV	4/30/2008
Zinc	NA	NA	--	D	IRIS	3/14/2017

[1] Idenitified as a mutagen on the Regional Screening Level (RSL) Table, May 2016, http://www.epa.gov/region09/waste/sfund/prg/index.html

[2] Date shown for IRIS is the date IRIS was searched. http://www.epa.gov/iris/ Date shown for other sources is the publication date.

[3] TCE is considered carcinogenic by a mutagenic mode of action for induction of kidney tumors. The adult-based IUR for kidney cancer is 1×10^{-6} per $\mu g/m^3$.

[4] IUR listed is based on continuous lifetime exposure during adulthood
The IUR for the continuous lifetime exposure from birth is 8.8×10^{-6} per $\mu g/m^3$.

[5] based on chromium (VI)

[6] based on vanadium pentoxide

EPA Weight of Evidence (EPA 1986, EPA 1996):
A - Human Carcinogen
B1 - Probable human carcinogen
indicates that limited human data are available
B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
C - Possible human carcinogen
D - Not classifiable as human carcinogen

Definition:
Cal/EPA = California Environmental Protection Agency
IRIS = Integrated Risk Information System
NA = not available
PPRTV = Provisional Peer Reviewed Toxicity Value
$\mu g/m^3$ = microgram per cubic meter

EPA Weight of Evidence Narrative (EPA 2005):
Carcinogenic to human
Likely to be carcinogenic to humans
Suggestive evidence of carcinogenic potential
Inadequate information to assess carcinogenic potential
Not likely to be carcinogenic to humans

IARC Classification:
3 - Not classifiable

TABLE B-7.0

CALCULATION OF CHEMICAL CANCER RISKS AND NONCANCER HAZARDS - TRICHLOROETHYLENE

GROUNDWATER FOR FUTURE RESIDENT

REASONABLE MAXIMUM EXPOSURE

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Common Exposure Parameters

Groundwater Concentration (CW)	125	µg/L	
Exposure Frequency	350	days	
Permeability Coefficient	0.012	cm/hr	(Table B-4.2)
Fraction Absorbed Water	1		(Table B-4.2)
Lag time	0.58	hr/day	(Table B-4.2)
Exposure Time - child	0.54	hr/day	(Table B-4.1a)
Exposure Time - adult	0.71	hr/day	(Table B-4.1a)

Ingestion

	Exposure Parameters					Cancer Risk Calculations						
C1	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*	*C8*	*C9*	*C10*	*C11*	*C12*	*C13*
Unit	kg	L/day	mg/L	yr	-	$(mg/kg/d)^{-1}$	-	-	$(mg/kg/d)^{-1}$	$(mg/kg/d)^{-1}$	-	-
Equation	-	-	CW/1000	-	*(C5 / 70 yr x EF / 365 days)*	-	-	*(C3 x C4 x C6 x C7 x C8 / C2)*	-	*(C10 − C7)*	*(C3 x C4 x C6 x C11 / C2)*	*(C9 + C12)*
Age group	Body Weight	Ingestion Rate	Exposure Concentration	Age Group Duration	Duration Adjustment	Kidney Slope Factor	Kidney Cancer ADAF	**Kidney ADAF-Adjusted Partial Risk**	Kidney+NHL+ Liver Slope Factor	NHL+Liver Slope Factor	**NHL+Liver Partial Risk**	**Total Partial Risk**
0 to <2 years	15	0.78	0.125	2	2.7E-02	9.3E-03	10	**1.7E-05**	4.6E-02	3.7E-02	**6.5E-06**	**2.3E-05**
2 to <6 years	15	0.78	0.125	4	5.5E-02	9.3E-03	3	**9.9E-06**	4.6E-02	3.7E-02	**1.3E-05**	**2.3E-05**
6 to <16 years	80	2.5	0.125	10	1.4E-01	9.3E-03	3	**1.5E-05**	4.6E-02	3.7E-02	**2.0E-05**	**3.5E-05**
16 to <26 years	80	2.5	0.125	10	1.4E-01	9.3E-03	1	**5.0E-06**	4.6E-02	3.7E-02	**2.0E-05**	**2.5E-05**
											Total Ingestion Risk	**1.1E-04**

Dermal Contact

	Exposure Parameters					Cancer Risk Calculations						
C1	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*	*C8*	*C9*	*C10*	*C11*	*C12*	*C13*
Unit	kg	cm^2/day	mg/cm^2	yr	-	$(mg/kg/d)^{-1}$	-	-	$(mg/kg/d)^{-1}$	$(mg/kg/d)^{-1}$	-	-
Equation	-	-	*Table B-4.2*	-	*(C5 / 70 yr x EF / 365 days)*	-	-	*(C3 x C4 x C6 x C7 x C8 / C2)*	-	*(C10 − C7)*	*(C3 x C4 x C6 x C11 / C2)*	*(C9 + C12)*
Age group	Body Weight	Skin Surface Area	Dermal Absorbed (DA_{event})	Age Group Duration	Duration Adjustment	Kidney Slope Factor	Kidney Cancer ADAF	**Kidney ADAF-Adjusted Partial Risk**	Kidney+NHL+ Liver Slope Factor	NHL+Liver Slope Factor	**NHL+Liver Partial Risk**	**Total Partial Risk**
0 to <2 years	15	6,378	2.6E-06	2	2.7E-02	9.3E-03	10	**2.8E-06**	4.6E-02	3.7E-02	**1.1E-06**	**3.9E-06**
2 to <6 years	15	6,378	2.6E-06	4	5.5E-02	9.3E-03	3	**1.7E-06**	4.6E-02	3.7E-02	**2.2E-06**	**3.9E-06**
6 to <16 years	80	20,900	2.6E-06	10	1.4E-01	9.3E-03	3	**2.6E-06**	4.6E-02	3.7E-02	**3.4E-06**	**6.0E-06**
16 to <26 years	80	20,900	2.6E-06	10	1.4E-01	9.3E-03	1	**8.6E-07**	4.6E-02	3.7E-02	**3.4E-06**	**4.3E-06**
											Total Dermal Risk	**1.8E-05**

TABLE B-7.0

CALCULATION OF CHEMICAL CANCER RISKS AND NONCANCER HAZARDS - TRICHLOROETHYLENE

GROUNDWATER FOR FUTURE RESIDENT

REASONABLE MAXIMUM EXPOSURE

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Inhalation of Volatile Chemicals

	Exposure Parameters					Cancer Risk Calculations						
C1	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*	*C8*	*C9*	*C10*	*C11*	*C12*	*C13*
Unit	hr/day	$\mu g/m^3$	$\mu g/m^3$	yr	-	$(\mu g/m^3)^{-1}$	-	-	$(\mu g/m^3)^{-1}$	$(\mu g/m^3)^{-1}$	-	-
Equation	-	Table D-3/D-4	*C3*	-	*(C5 / 70 yr x C2 / 24 hrs x EF / 365 days)*	-	-	*(C4 x C6 x C7 x C8)*	-	*(C10 − C7)*	*(C4 x C6 x C11)*	*(C9 + C12)*
Age group	Exposure Time	Chemical Concentration in Air	Exposure Concentration	Age Group Duration	Duration Adjustment	Kidney Unit Risk	Kidney Cancer ADAF	**Kidney ADAF-Adjusted Partial Risk**	Kidney+NHL+ Liver Unit Risk	NHL+Liver Unit Risk	**NHL+Liver Partial Risk**	**Total Partial Risk**
0 to <2 years	0.54	3.6E+03	3.6E+03	2	6.2E-04	1.0E-06	10	**2.2E-05**	4.1E-06	3.1E-06	**6.9E-06**	**2.9E-05**
2 to <6 years	0.54	3.6E+03	3.6E+03	4	1.2E-03	1.0E-06	3	**1.3E-05**	4.1E-06	3.1E-06	**1.4E-05**	**2.7E-05**
6 to <16 years	0.71	3.8E+03	3.8E+03	10	4.1E-03	1.0E-06	3	**4.7E-05**	4.1E-06	3.1E-06	**4.8E-05**	**9.5E-05**
16 to <26 years	0.71	3.8E+03	3.8E+03	10	4.1E-03	1.0E-06	1	**1.6E-05**	4.1E-06	3.1E-06	**4.8E-05**	**6.4E-05**
											Total Inhalation Risk	**2.1E-04**

ADAF = age-dependent adjustment factors

Source:

(1) EPA 2011. Toxicological Review of Trichloroethylene (CAS No. 79-01-6) in Support of Summary Information on the Integrated Risk Information System (IRIS). September

TABLE B-7.1
CALCULATION OF CHEMICAL CANCER RISKS AND NONCANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Scenario Timeframe:	Future
Receptor Population:	Resident
Receptor Age:	Lifetime[1]

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Exposure Point Concentration		Cancer Risk Calculation					Noncancer Hazard Calculation				
							Intake/ Exposure Concentration		Slope Factor/Unit Risk		Cancer	Intake/ Exposure Concentration		RfD/RfC		Hazard
					Value	Unit	Value	Unit	Value	Unit	Risk	Value	Unit	Value	Unit	Quotient
Groundwater	Groundwater	Groundwater	Ingestion	**Volatile Organic Compounds**												
				1,1-Dichloroethane	1.18E+01	µg/L	1.52E-04	mg/kg-day	5.70E-03	$(mg/kg-day)^{-1}$	8.64E-07	5.89E-04	mg/kg-day	2.00E-01	mg/kg-day	2.94E-03
				1,1-Dichloroethene	1.46E+01	µg/L	1.87E-04	mg/kg-day	NA	NA	NA	7.26E-04	mg/kg-day	5.00E-02	mg/kg-day	1.45E-02
				Benzene	2.32E-01	µg/L	2.98E-06	mg/kg-day	5.50E-02	$(mg/kg-day)^{-1}$	1.64E-07	1.16E-05	mg/kg-day	4.00E-03	mg/kg-day	2.89E-03
				Carbon Tetrachloride	4.90E-01	µg/L	6.29E-06	mg/kg-day	7.00E-02	$(mg/kg-day)^{-1}$	4.40E-07	2.44E-05	mg/kg-day	4.00E-03	mg/kg-day	6.11E-03
				Chloroform	1.00E+00	µg/L	1.28E-05	mg/kg-day	3.10E-02	$(mg/kg-day)^{-1}$	3.98E-07	4.99E-05	mg/kg-day	1.00E-02	mg/kg-day	4.99E-03
				cis-1,2-Dichloroethene	6.48E+00	µg/L	8.32E-05	mg/kg-day	NA	NA	NA	3.23E-04	mg/kg-day	2.00E-03	mg/kg-day	1.62E-01
				Ethylbenzene	2.80E+00	µg/L	3.59E-05	mg/kg-day	1.10E-02	$(mg/kg-day)^{-1}$	3.95E-07	1.40E-04	mg/kg-day	1.00E-01	mg/kg-day	1.40E-03
				Methyl Tert-Butyl Ether	1.05E+01	µg/L	1.35E-04	mg/kg-day	1.80E-03	$(mg/kg-day)^{-1}$	2.44E-07	5.26E-04	mg/kg-day	NA	NA	NA
				Tetrachloroethene	4.07E+02	µg/L	5.22E-03	mg/kg-day	2.10E-03	$(mg/kg-day)^{-1}$	1.10E-05	2.03E-02	mg/kg-day	6.00E-03	mg/kg-day	3.38E+00
				Trichloroethene	1.25E+02	µg/L	See Table B-7.0	NA	4.60E-02	$(mg/kg-day)^{-1}$	1.05E-04	6.23E-03	mg/kg-day	5.00E-04	mg/kg-day	1.25E+01
				Vinyl Chloride	9.10E+00	µg/L	5.90E-04	mg/kg-day	7.20E-01	$(mg/kg-day)^{-1}$	4.25E-04	4.54E-04	mg/kg-day	3.00E-03	mg/kg-day	1.51E-01
				Inorganics												
				Arsenic	3.10E+00	µg/L	3.98E-05	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	5.97E-05	1.55E-04	mg/kg-day	3.00E-04	mg/kg-day	5.15E-01
				Chromium	8.90E+00	µg/L	1.14E-04	mg/kg-day	5.00E-01	$(mg/kg-day)^{-1}$	5.71E-05	4.44E-04	mg/kg-day	3.00E-03	mg/kg-day	1.48E-01
				Cobalt	6.90E+00	µg/L	8.86E-05	mg/kg-day	NA	NA	NA	3.44E-04	mg/kg-day	3.00E-04	mg/kg-day	1.15E+00
				Vanadium	9.10E+00	µg/L	1.17E-04	mg/kg-day	NA	NA	NA	4.54E-04	mg/kg-day	9.00E-03	mg/kg-day	5.04E-02
				Zinc	9.50E+02	µg/L	1.22E-02	mg/kg-day	NA	NA	NA	4.74E-02	mg/kg-day	3.00E-01	mg/kg-day	1.58E-01
			Exp. Route Total								6.60E-04					1.82E+01
Groundwater	Groundwater	Groundwater	Dermal	**Volatile Organic Compounds**												
			Contact	1,1-Dichloroethane	1.18E+01	µg/L	1.18E-05	mg/kg-day	5.70E-03	$(mg/kg-day)^{-1}$	6.70E-08	4.50E-05	mg/kg-day	2.00E-01	mg/kg-day	2.25E-04
				1,1-Dichloroethene	1.46E+01	µg/L	2.56E-05	mg/kg-day	NA	NA	NA	9.81E-05	mg/kg-day	5.00E-02	mg/kg-day	1.96E-03
				Benzene	2.32E-01	µg/L	4.52E-07	mg/kg-day	5.50E-02	$(mg/kg-day)^{-1}$	2.49E-08	1.73E-06	mg/kg-day	4.00E-03	mg/kg-day	4.32E-04
				Carbon Tetrachloride	4.90E-01	µg/L	1.67E-06	mg/kg-day	7.00E-02	$(mg/kg-day)^{-1}$	1.17E-07	6.39E-06	mg/kg-day	4.00E-03	mg/kg-day	1.60E-03
				Chloroform	1.00E+00	µg/L	1.16E-06	mg/kg-day	3.10E-02	$(mg/kg-day)^{-1}$	3.59E-08	4.44E-06	mg/kg-day	1.00E-02	mg/kg-day	4.44E-04
				cis-1,2-Dichloroethene	6.48E+00	µg/L	NA	NA	NA	NA	NA	NA	NA	2.00E-03	mg/kg-day	NA
				Ethylbenzene	2.80E+00	µg/L	2.14E-05	mg/kg-day	1.10E-02	$(mg/kg-day)^{-1}$	2.36E-07	8.21E-05	mg/kg-day	1.00E-01	mg/kg-day	8.21E-04
				Methyl Tert-Butyl Ether	1.05E+01	µg/L	NA	NA	1.80E-03	$(mg/kg-day)^{-1}$	NA	NA	NA	NA	NA	NA
				Tetrachloroethene	4.07E+02	µg/L	3.09E-03	mg/kg-day	2.10E-03	$(mg/kg-day)^{-1}$	6.48E-06	1.18E-02	mg/kg-day	6.00E-03	mg/kg-day	1.97E+00
				Trichloroethene	1.25E+02	µg/L	See Table B-7.0	NA	4.60E-02	$(mg/kg-day)^{-1}$	1.80E-05	1.05E-03	mg/kg-day	5.00E-04	mg/kg-day	2.11E+00
				Vinyl Chloride	9.10E+00	µg/L	3.12E-05	mg/kg-day	7.20E-01	$(mg/kg-day)^{-1}$	2.25E-05	2.39E-05	mg/kg-day	3.00E-03	mg/kg-day	7.97E-03
				Inorganics												
				Arsenic	3.10E+00	µg/L	2.22E-07	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	3.32E-07	8.48E-07	mg/kg-day	3.00E-04	mg/kg-day	2.83E-03
				Chromium	8.90E+00	µg/L	6.36E-07	mg/kg-day	5.00E-01	$(mg/kg-day)^{-1}$	3.18E-07	2.43E-06	mg/kg-day	7.50E-05	mg/kg-day	3.25E-02
				Cobalt	6.90E+00	µg/L	1.97E-07	mg/kg-day	NA	NA	NA	7.55E-07	mg/kg-day	3.00E-04	mg/kg-day	2.52E-03
				Vanadium	9.10E+00	µg/L	6.50E-07	mg/kg-day	NA	NA	NA	2.49E-06	mg/kg-day	2.34E-04	mg/kg-day	1.06E-02
				Zinc	9.50E+02	µg/L	4.07E-05	mg/kg-day	NA	NA	NA	1.56E-04	mg/kg-day	3.00E-01	mg/kg-day	5.20E-04
			Exp. Route Total								4.81E-05					4.14E+00

TABLE B-7.1
CALCULATION OF CHEMICAL CANCER RISKS AND NONCANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Scenario Timeframe:	Future
Receptor Population:	Resident
Receptor Age:	Lifetime[1]

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Exposure Point Concentration		Cancer Risk Calculation					Noncancer Hazard Calculation				
							Intake/ Exposure Concentration		Slope Factor/Unit Risk		Cancer	Intake/ Exposure Concentration		RfD/RfC		Hazard
					Value	Unit	Value	Unit	Value	Unit	Risk	Value	Unit	Value	Unit	Quotient
Groundwater	Groundwater	Groundwater	Inhalation	**Volatile Organic Compounds**												
				1,1-Dichloroethane	1.18E+01	µg/L	3.65E+00	µg/m^3	1.60E-06	(µg/m^3)$^{-1}$	5.84E-06	7.53E-03	mg/m^3	NA	NA	NA
				1,1-Dichloroethene	1.46E+01	µg/L	4.62E+00	µg/m^3	NA	NA	NA	9.52E-03	mg/m^3	2.00E-01	mg/m^3	4.76E-02
				Benzene	2.32E-01	µg/L	7.04E-02	µg/m^3	7.80E-06	(µg/m^3)$^{-1}$	5.49E-07	1.45E-04	mg/m^3	3.00E-02	mg/m^3	4.84E-03
				Carbon Tetrachloride	4.90E-01	µg/L	1.44E-01	µg/m^3	6.00E-06	(µg/m^3)$^{-1}$	8.62E-07	2.96E-04	mg/m^3	1.00E-01	mg/m^3	2.96E-03
				Chloroform	1.00E+00	µg/L	3.15E-01	µg/m^3	2.30E-05	(µg/m^3)$^{-1}$	7.25E-06	6.50E-04	mg/m^3	3.00E-01	mg/m^3	2.17E-03
				cis-1,2-Dichloroethene	6.48E+00	µg/L	2.09E+00	µg/m^3	NA	NA	NA	4.32E-03	mg/m^3	NA	NA	NA
				Ethylbenzene	2.80E+00	µg/L	7.44E-01	µg/m^3	2.50E-06	(µg/m^3)$^{-1}$	1.86E-06	1.53E-03	mg/m^3	1.00E+00	mg/m^3	1.53E-03
				Methyl Tert-Butyl Ether	1.05E+01	µg/L	2.83E+00	µg/m^3	2.60E-07	(µg/m^3)$^{-1}$	7.36E-07	5.84E-03	mg/m^3	3.00E+00	mg/m^3	1.95E-03
				Tetrachloroethene	4.07E+02	µg/L	1.17E+02	µg/m^3	2.60E-07	(µg/m^3)$^{-1}$	3.03E-05	2.40E-01	mg/m^3	4.00E-02	mg/m^3	6.01E+00
				Trichloroethene	1.25E+02	µg/L	See Table B-7.0	NA	4.10E-06	(µg/m^3)$^{-1}$	2.14E-04	7.77E-02	mg/m^3	2.00E-03	mg/m^3	3.88E+01
				Vinyl Chloride	9.10E+00	µg/L	2.95E+02	µg/m^3	4.40E-06	(µg/m^3)$^{-1}$	1.30E-03	6.31E-03	mg/m^3	1.00E-01	mg/m^3	6.31E-02
			Exp. Route Total								1.56E-03					4.50E+01
		Exposure Point Total									2.27E-03					6.73E+01

NA = not applicable
RfD = reference dose
RfC = reference concentration
µg/L = microgram per liter
mg/kg-day = milligram per kilogram per day
µg/m^3 = microgram per cubic meter
mg/m^3 = milligram per cubic meter

[1] cancer risk is based on age-adjusted scenario and noncancer hazard index is based on child exposure scenario

TABLE B-7.2

CALCULATION OF CHEMICAL CANCER RISKS AND NONCANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Scenario Timeframe:	Future
Receptor Population:	Site Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Exposure Point Concentration		Cancer Risk Calculation					Noncancer Hazard Calculation				
							Intake/ Exposure Concentration		Slope Factor/Unit Risk		Cancer	Intake/ Exposure Concentration		RfD/RfC		Hazard
					Value	Unit	Value	Unit	Value	Unit	Risk	Value	Unit	Value	Unit	Quotient
Groundwater	Groundwater	Groundwater	Ingestion	**Volatile Organic Compounds**												
				1,1-Dichloroethane	1.18E+01	µg/L	9.03E-05	mg/kg-day	5.70E-03	$(mg/kg-day)^{-1}$	5.15E-07	2.53E-04	mg/kg-day	2.00E-01	mg/kg-day	1.26E-03
				1,1-Dichloroethene	1.46E+01	µg/L	1.11E-04	mg/kg-day	NA	NA	NA	3.12E-04	mg/kg-day	5.00E-02	mg/kg-day	6.23E-03
				Benzene	2.32E-01	µg/L	1.77E-06	mg/kg-day	5.50E-02	$(mg/kg-day)^{-1}$	9.75E-08	4.97E-06	mg/kg-day	4.00E-03	mg/kg-day	1.24E-03
				Carbon Tetrachloride	4.90E-01	µg/L	3.75E-06	mg/kg-day	7.00E-02	$(mg/kg-day)^{-1}$	2.62E-07	1.05E-05	mg/kg-day	4.00E-03	mg/kg-day	2.62E-03
				Chloroform	1.00E+00	µg/L	7.64E-06	mg/kg-day	3.10E-02	$(mg/kg-day)^{-1}$	2.37E-07	2.14E-05	mg/kg-day	1.00E-02	mg/kg-day	2.14E-03
				cis-1,2-Dichloroethene	6.48E+00	µg/L	4.96E-05	mg/kg-day	NA	NA	NA	1.39E-04	mg/kg-day	2.00E-03	mg/kg-day	6.94E-02
				Ethylbenzene	2.80E+00	µg/L	2.14E-05	mg/kg-day	1.10E-02	$(mg/kg-day)^{-1}$	2.35E-07	5.99E-05	mg/kg-day	1.00E-01	mg/kg-day	5.99E-04
				Methyl Tert-Butyl Ether	1.05E+01	µg/L	8.06E-05	mg/kg-day	1.80E-03	$(mg/kg-day)^{-1}$	1.45E-07	2.26E-04	mg/kg-day	NA	NA	NA
				Tetrachloroethene	4.07E+02	µg/L	3.11E-03	mg/kg-day	2.10E-03	$(mg/kg-day)^{-1}$	6.53E-06	8.71E-03	mg/kg-day	6.00E-03	mg/kg-day	1.45E+00
				Trichloroethene	1.25E+02	µg/L	9.56E-04	NA	4.60E-02	$(mg/kg-day)^{-1}$	1.05E-04	2.68E-03	mg/kg-day	5.00E-04	mg/kg-day	5.35E+00
				Vinyl Chloride	9.10E+00	µg/L	6.96E-05	mg/kg-day	7.20E-01	$(mg/kg-day)^{-1}$	5.01E-05	1.95E-04	mg/kg-day	3.00E-03	mg/kg-day	6.49E-02
				Inorganics												
				Arsenic	3.10E+00	µg/L	2.37E-05	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	3.55E-05	6.64E-05	mg/kg-day	3.00E-04	mg/kg-day	2.21E-01
				Chromium	8.90E+00	µg/L	6.80E-05	mg/kg-day	5.00E-01	$(mg/kg-day)^{-1}$	3.40E-05	1.90E-04	mg/kg-day	3.00E-03	mg/kg-day	6.35E-02
				Cobalt	6.90E+00	µg/L	5.27E-05	mg/kg-day	NA	NA	NA	1.48E-04	mg/kg-day	3.00E-04	mg/kg-day	4.92E-01
				Vanadium	9.10E+00	µg/L	6.96E-05	mg/kg-day	NA	NA	NA	1.95E-04	mg/kg-day	9.00E-03	mg/kg-day	2.16E-02
				Zinc	9.50E+02	µg/L	7.26E-03	mg/kg-day	NA	NA	NA	2.03E-02	mg/kg-day	3.00E-01	mg/kg-day	6.78E-02
			Exp. Route Total								2.33E-04					7.82E+00
		Exposure Point Total									2.33E-04					7.82E+00

NA = not applicable

RfD = reference dose

RfC = reference concentration

µg/L = microgram per liter

mg/kg-day = milligram per kilogram per day

TABLE B-8
CALCULATION OF RADIATION CANCER RISKS
REASONABLE MAXIMUM EXPOSURE
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Scenario Timeframe:	NA
Receptor Population:	NA
Receptor Age:	NA

Medium	Exposure Medium	Exposure Point	Exposure Route	Radionuclide of Potential Concern	Exposure Point Concentration		Risk Calculation Approach	Cancer Risk Calculation				
								Intake/Activity		Cancer Slope Factor		
					Value	Unit		Value	Unit	Value	Unit	Cancer Risk
				NOT APPLICABLE TO THIS SITE								
			Exp. Route Total									
		Exposure Point Total										
											Total of Receptor Risks Across All Media	

There are no radionucleotides in this risk assessment. As a result, this table is blank

TABLE B-9.1

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR CHEMICALS OF POTENTIAL CONCERN

REASONABLE MAXIMUM EXPOSURE

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Scenario Timeframe:	Future
Receptor Population:	Resident
Receptor Age:	Lifetime[1]

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient				
				Ingestion	Dermal Contact	Inhalation	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Dermal Contact	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Groundwater	**Volatile Organic Compounds**									
			1,1-Dichloroethane	9E-07	7E-08	6E-06	7E-06	Kidney	2.94E-03	2.25E-04	NA	3.17E-03
			1,1-Dichloroethene	NA	NA	NA	NA	Liver	1.45E-02	1.96E-03	4.76E-02	6.41E-02
			Benzene	2E-07	2E-08	5E-07	7E-07	Blood	2.89E-03	4.32E-04	4.84E-03	8.16E-03
			Carbon Tetrachloride	4E-07	1E-07	9E-07	1E-06	Liver/Kidney	6.11E-03	1.60E-03	2.96E-03	1.07E-02
			Chloroform	4E-07	4E-08	7E-06	8E-06	Liver/Alimentary System/ Kidney/Development	4.99E-03	4.44E-04	2.17E-03	7.60E-03
			cis-1,2-Dichloroethene	NA	NA	NA	NA	Kidney	1.62E-01	NA	NA	1.62E-01
			Ethylbenzene	4E-07	2E-07	2E-06	2E-06	Liver/Kidney	1.40E-03	8.21E-04	1.53E-03	3.75E-03
			Methyl Tert-Butyl Ether	2E-07	NA	7E-07	1E-06	Liver/Kidney	NA	NA	1.95E-03	1.95E-03
			Tetrachloroethene	1E-05	6E-06	3E-05	5E-05	Nervous System/Liver/ Kidney/CNS	3.38E+00	1.97E+00	6.01E+00	1.14E+01
			Trichloroethene	1E-04	2E-05	2E-04	3E-04	Heart/ Immune System/ Development/Kidney/Liver	1.25E+01	2.11E+00	3.88E+01	5.34E+01
			Vinyl Chloride	4E-04	2E-05	1E-03	2E-03	Liver	1.51E-01	7.97E-03	6.31E-02	2.22E-01
			Inorganics									
			Arsenic	6E-05	3E-07	NA	6E-05	Development/Cardiovascular System/Nervous System/ Lung/Skin	5.15E-01	2.83E-03	NA	5.18E-01
			Chromium	6E-05	3E-07	NA	6E-05	Lung	1.48E-01	3.25E-02	NA	1.80E-01
			Cobalt	NA	NA	NA	NA	Thyroid/Respiratory System/ Lung	1.15E+00	2.52E-03	NA	1.15E+00
			Vanadium	NA	NA	NA	NA	Hair/Respiratory System	5.04E-02	1.06E-02	NA	6.11E-02
			Zinc	NA	NA	NA	NA	Development	1.58E-01	5.20E-04	NA	1.58E-01
			Chemical Total	7E-04	5E-05	2E-03	2E-03	Chemical Total	1.82E+01	4.14E+00	4.50E+01	6.73E+01
		Exposure Point Total					2E-03					6.73E+01
	Exposure Medium Total						2E-03					6.73E+01
Medium Total							2E-03					6.73E+01
Receptor Total							2E-03					6.73E+01

Total Excess Cancer Risk Across All Media	2E-03
Total Hazard Index (HI) Across All Media	67
Alimentary System HI Across All Media =	<0.01
Blood HI Across All Media =	<0.01
Cardiovascular System HI Across All Media =	0.5
CNS HI Across All Media =	11
Development HI Across All Media =	54
Hair HI Across All Media =	0.06
Heart HI Across All Media =	53
Immune system HI Across All Media =	53
Kidney HI Across All Media =	65
Liver HI Across All Media =	65
Lung HI Across All Media =	2
Nervous System HI Across All Media =	12
Respiratory System HI Across All Media =	1
Skin HI Across All Media =	0.5
Thyroid HI Across All Media =	1

NA = not applicable

CNS = central nervous system

[1] cancer risk is based on age-adjusted scenario and noncancer hazard index is based on child exposure scenario

TABLE B-9.2

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR CHEMICALS OF POTENTIAL CONCERN

REASONABLE MAXIMUM EXPOSURE

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Scenario Timeframe:	Future
Receptor Population:	Site Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient				
				Ingestion	Dermal Contact	Inhalation	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Dermal Contact	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Groundwater	**Volatile Organic Compounds**									
			1,1-Dichloroethane	5E-07	NA	NA	5E-07	Kidney	1.26E-03	NA	NA	1.26E-03
			1,1-Dichloroethene	NA	NA	NA	NA	Liver	6.23E-03	NA	NA	6.23E-03
			Benzene	1E-07	NA	NA	1E-07	Blood	1.24E-03	NA	NA	1.24E-03
			Carbon Tetrachloride	3E-07	NA	NA	3E-07	Liver/Kidney	2.62E-03	NA	NA	2.62E-03
			Chloroform	2E-07	NA	NA	2E-07	Liver/Alimentary System/ Kidney/Development	2.14E-03	NA	NA	2.14E-03
			cis-1,2-Dichloroethene	NA	NA	NA	NA	Kidney	6.94E-02	NA	NA	6.94E-02
			Ethylbenzene	2E-07	NA	NA	2E-07	Liver/Kidney	5.99E-04	NA	NA	5.99E-04
			Methyl Tert-Butyl Ether	1E-07	NA	NA	1E-07	Liver/Kidney	NA	NA	NA	NA
			Tetrachloroethene	7E-06	NA	NA	7E-06	Nervous System/Liver/ Kidney/CNS	1.45E+00	NA	NA	1.45E+00
			Trichloroethene	1E-04	NA	NA	1E-04	Heart/ Immune System/ Development/Kidney/Liver	5.35E+00	NA	NA	5.35E+00
			Vinyl Chloride	5E-05	NA	NA	5E-05	Liver	6.49E-02	NA	NA	6.49E-02
			Inorganics									
			Arsenic	4E-05	NA	NA	4E-05	Development/Cardiovascular System/Nervous System/ Lung/Skin	2.21E-01	NA	NA	2.21E-01
			Chromium	3E-05	NA	NA	3E-05	Lung	6.35E-02	NA	NA	6.35E-02
			Cobalt	NA	NA	NA	NA	Thyroid/Respiratory System/ Lung	4.92E-01	NA	NA	4.92E-01
			Vanadium	NA	NA	NA	NA	Hair/Respiratory System	2.16E-02	NA	NA	2.16E-02
			Zinc	NA	NA	NA	NA	Development	6.78E-02	NA	NA	6.78E-02
			Chemical Total	2E-04	--	--	2E-04	Chemical Total	7.82E+00	--	--	7.82E+00
		Exposure Point Total					2E-04					7.82E+00
	Exposure Medium Total						2E-04					7.82E+00
Medium Total							2E-04					7.82E+00
Receptor Total							2E-04					7.82E+00

Total Excess Cancer Risk Across All Media	2E-04
Total Hazard Index (HI) Across All Media	8
Alimentary System HI Across All Media =	<0.01
Blood HI Across All Media =	<0.01
Cardiovascular System HI Across All Media =	0.2
CNS HI Across All Media =	1
Development HI Across All Media =	6
Hair HI Across All Media =	0.02
Heart HI Across All Media =	5
Immune system HI Across All Media =	5
Kidney HI Across All Media =	7
Liver HI Across All Media =	7
Lung HI Across All Media =	0.8
Nervous System HI Across All Media =	2
Respiratory System HI Across All Media =	0.5
Skin HI Across All Media =	0.2
Thyroid HI Across All Media =	0.5

NA = not applicable

CNS = central nervous system

CDM Smith

TABLE B-10.1
RISK ASSESSMENT SUMMARY
REASONABLE MAXIMUM EXPOSURE
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Scenario Timeframe:	Future
Receptor Population:	Resident
Receptor Age:	Lifetime[1]

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient				
				Ingestion	Dermal Contact	Inhalation	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Dermal Contact	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Groundwater	**Volatile Organic Compounds**									
			1,1-Dichloroethane	9E-07	7E-08	6E-06	7E-06	Kidney	2.94E-03	2.25E-04	NA	3.17E-03
			Carbon Tetrachloride	4E-07	1E-07	9E-07	1E-06	Liver/Kidney	6.11E-03	1.60E-03	2.96E-03	1.07E-02
			Chloroform	4E-07	4E-08	7E-06	8E-06	Liver/Alimentary System/ Kidney/Development	4.99E-03	4.44E-04	2.17E-03	7.60E-03
			Ethylbenzene	4E-07	2E-07	2E-06	2E-06	Liver/Kidney	1.40E-03	8.21E-04	1.53E-03	3.75E-03
			Tetrachloroethene	1E-05	6E-06	3E-05	5E-05	Nervous System/Liver/ Kidney/CNS	3.38E+00	1.97E+00	6.01E+00	1.14E+01
			Trichloroethene	1E-04	2E-05	2E-04	3E-04	Heart/ Immune System/ Development/Kidney/Liver	1.25E+01	2.11E+00	3.88E+01	5.34E+01
			Vinyl Chloride	4E-04	2E-05	1E-03	2E-03	Liver	1.51E-01	7.97E-03	6.31E-02	2.22E-01
			Inorganics									
			Arsenic	6E-05	3E-07	NA	6E-05	Development/Cardiovascular System/Nervous System/ Lung/Skin	5.15E-01	2.83E-03	NA	5.18E-01
			Chromium	6E-05	3E-07	NA	6E-05	Lung	1.48E-01	3.25E-02	NA	1.80E-01
			Cobalt	NA	NA	NA	NA	Thyroid/Respiratory System/ Lung	1.15E+00	2.52E-03	NA	1.15E+00
			Chemical Total	7E-04	5E-05	2E-03	2E-03	Chemical Total	1.82E+01	4.14E+00	4.50E+01	6.73E+01
		Exposure Point Total					2E-03					6.73E+01
	Exposure Medium Total						2E-03					6.73E+01
Medium Total							2E-03					6.73E+01
Receptor Total							2E-03					6.73E+01

Total Excess Cancer Risk Across All Media	2E-03
Total Hazard Index (HI) Across All Media	67
CNS HI Across All Media =	11
Development HI Across All Media =	54
Heart HI Across All Media =	53
Immune system HI Across All Media =	53
Kidney HI Across All Media =	65
Liver HI Across All Media =	65
Lung HI Across All Media =	2
Nervous System HI Across All Media =	12
Respiratory System HI Across All Media =	1
Thyroid HI Across All Media =	1

Note:
Only chemicals above EPA's threshold values are listed in this table
[1] cancer risk is based on age-adjusted scenario and noncancer hazard index is based on child exposure scenario

TABLE B-10.2

RISK ASSESSMENT SUMMARY

REASONABLE MAXIMUM EXPOSURE

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Scenario Timeframe:	Future
Receptor Population:	Site Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient				
				Ingestion	Dermal Contact	Inhalation	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Dermal Contact	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Groundwater	**Volatile Organic Compounds**									
			Tetrachloroethene	7E-06	NA	NA	7E-06	Nervous System/Liver/ Kidney/CNS	1.45E+00	NA	NA	1.45E+00
			Trichloroethene	1E-04	NA	NA	1E-04	Heart/ Immune System/ Development/Kidney/Liver	5.35E+00	NA	NA	5.35E+00
			Vinyl Chloride	5E-05	NA	NA	5E-05	Liver	6.49E-02	NA	NA	6.49E-02
			Inorganics									
			Arsenic	4E-05	NA	NA	4E-05	Development/Cardiovascular System/Nervous System/ Lung/Skin	2.21E-01	NA	NA	2.21E-01
			Chromium	3E-05	NA	NA	3E-05	Lung	6.35E-02	NA	NA	6.35E-02
			Chemical Total	2E-04	--	--	2E-04	Chemical Total	7.82E+00	--	--	7.82E+00
		Exposure Point Total					2E-04					7.82E+00
	Exposure Medium Total						2E-04					7.82E+00
Medium Total							2E-04					7.82E+00
Receptor Total							2E-04					7.82E+00

Total Excess Cancer Risk Across All Media	2E-04
Total Hazard Index (HI) Across All Media	8
CNS HI Across All Media =	1
Development HI Across All Media =	6
Heart HI Across All Media =	5
Immune system HI Across All Media =	5
Kidney HI Across All Media =	7
Liver HI Across All Media =	7
Nervous System HI Across All Media =	2

Note:
Only chemicals above EPA's threshold values are listed in this table

Appendix C

Appendix C

ProUCL Output for Chemicals of Potential Concern

Appendix C-1 ProUCL Output – Groundwater

APPENDIX C
GROUNDWATER PROUCL Output
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.13/11/2017 11:43:44 PM
From File	ORF_ProUCL_Input.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

COPC (1,1-dichloroethane)

General Statistics

Total Number of Observations	13	Number of Distinct Observations	9
Number of Detects	7	Number of Non-Detects	6
Number of Distinct Detects	7	Number of Distinct Non-Detects	2
Minimum Detect	0.86	Minimum Non-Detect	0.5
Maximum Detect	24	Maximum Non-Detect	5
Variance Detects	66.94	Percent Non-Detects	46.15%
Mean Detects	5.637	SD Detects	8.182
Median Detects	2.6	CV Detects	1.451
Skewness Detects	2.535	Kurtosis Detects	6.541
Mean of Logged Detects	1.165	SD of Logged Detects	1.025

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.583	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.398	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	3.951	KM Standard Error of Mean	1.802
KM SD	5.922	95% KM (BCA) UCL	7.067
95% KM (t) UCL	7.163	95% KM (Percentile Bootstrap) UCL	7.187
95% KM (z) UCL	6.915	95% KM Bootstrap t UCL	15.77
90% KM Chebyshev UCL	9.358	95% KM Chebyshev UCL	11.81
97.5% KM Chebyshev UCL	15.21	99% KM Chebyshev UCL	21.88

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.87	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.727	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.338	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.319	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	1.02	k star (bias corrected MLE)	0.678
Theta hat (MLE)	5.526	Theta star (bias corrected MLE)	8.312
nu hat (MLE)	14.28	nu star (bias corrected)	9.494
Mean (detects)	5.637		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	4.03
Maximum	24	Median	2.5
SD	6.384	CV	1.584
k hat (MLE)	0.422	k star (bias corrected MLE)	0.376
Theta hat (MLE)	9.553	Theta star (bias corrected MLE)	10.72
nu hat (MLE)	10.97	nu star (bias corrected)	9.77
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (9.77, α)	3.799	Adjusted Chi Square Value (9.77, β)	3.286
95% Gamma Approximate UCL (use when n>=50)	10.37	95% Gamma Adjusted UCL (use when n<50)	11.98

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	3.951	SD (KM)	5.922
Variance (KM)	35.07	SE of Mean (KM)	1.802
k hat (KM)	0.445	k star (KM)	0.394
nu hat (KM)	11.57	nu star (KM)	10.23
theta hat (KM)	8.877	theta star (KM)	10.04
80% gamma percentile (KM)	6.364	90% gamma percentile (KM)	11.19
95% gamma percentile (KM)	16.51	99% gamma percentile (KM)	29.9

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (10.23, α)	4.089	Adjusted Chi Square Value (10.23, β)	3.552
95% Gamma Approximate KM-UCL (use when n>=50)	9.889	95% Gamma Adjusted KM-UCL (use when n<50)	11.38

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.877	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.803	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.281	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.304	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.999	Mean in Log Scale	0.797
SD in Original Scale	6.186	SD in Log Scale	1.051
95% t UCL (assumes normality of ROS data)	7.057	95% Percentile Bootstrap UCL	7.222
95% BCA Bootstrap UCL	8.291	95% Bootstrap t UCL	14.12
95% H-UCL (Log ROS)	9.404		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.809	KM Geo Mean	2.246
KM SD (logged)	0.968	95% Critical H Value (KM-Log)	2.793
KM Standard Error of Mean (logged)	0.338	95% H-UCL (KM -Log)	7.835
KM SD (logged)	0.968	95% Critical H Value (KM-Log)	2.793
KM Standard Error of Mean (logged)	0.338		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	4.016	Mean in Log Scale	0.873
SD in Original Scale	6.094	SD in Log Scale	1.001
95% t UCL (Assumes normality)	7.029	95% H-Stat UCL	8.994

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use
95% KM (Chebyshev) UCL 11.81

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

COPC (1,1-dichloroethene)

General Statistics

Total Number of Observations	13	Number of Distinct Observations	7
Number of Detects	6	Number of Non-Detects	7
Number of Distinct Detects	5	Number of Distinct Non-Detects	2
Minimum Detect	1.3	Minimum Non-Detect	0.5
Maximum Detect	44	Maximum Non-Detect	5
Variance Detects	276.4	Percent Non-Detects	53.85%
Mean Detects	15.12	SD Detects	16.63
Median Detects	11.7	CV Detects	1.1
Skewness Detects	1.164	Kurtosis Detects	0.913
Mean of Logged Detects	1.992	SD of Logged Detects	1.449

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.835	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.26	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.325	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	7.846	KM Standard Error of Mean	3.765
KM SD	12.34	95% KM (BCA) UCL	14.25
95% KM (t) UCL	14.56	95% KM (Percentile Bootstrap) UCL	14.43
95% KM (z) UCL	14.04	95% KM Bootstrap t UCL	19.12
90% KM Chebyshev UCL	19.14	95% KM Chebyshev UCL	24.26
97.5% KM Chebyshev UCL	31.36	99% KM Chebyshev UCL	45.31

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.427	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.719	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.254	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.343	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.818	k star (bias corrected MLE)	0.52
Theta hat (MLE)	18.48	Theta star (bias corrected MLE)	29.06
nu hat (MLE)	9.817	nu star (bias corrected)	6.242
Mean (detects)	15.12		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	7.901
Maximum	44	Median	2
SD	12.98	CV	1.643
k hat (MLE)	0.284	k star (bias corrected MLE)	0.27
Theta hat (MLE)	27.8	Theta star (bias corrected MLE)	29.27
nu hat (MLE)	7.39	nu star (bias corrected)	7.018
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (7.02, α)	2.18	Adjusted Chi Square Value (7.02, β)	1.817
95% Gamma Approximate UCL (use when n>=50)	25.43	95% Gamma Adjusted UCL (use when n<50)	30.51

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	7.846	SD (KM)	12.34
Variance (KM)	152.3	SE of Mean (KM)	3.765
k hat (KM)	0.404	k star (KM)	0.362
nu hat (KM)	10.51	nu star (KM)	9.42
theta hat (KM)	19.41	theta star (KM)	21.66
80% gamma percentile (KM)	12.49	90% gamma percentile (KM)	22.54
95% gamma percentile (KM)	33.72	99% gamma percentile (KM)	62.16

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (9.42, α)	3.582	Adjusted Chi Square Value (9.42, β)	3.087
95% Gamma Approximate KM-UCL (use when n>=50)	20.63	95% Gamma Adjusted KM-UCL (use when n<50)	23.94

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.896	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.256	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	7.918	Mean in Log Scale	0.918
SD in Original Scale	12.84	SD in Log Scale	1.641
95% t UCL (assumes normality of ROS data)	14.27	95% Percentile Bootstrap UCL	14.39
95% BCA Bootstrap UCL	16.83	95% Bootstrap t UCL	19.96
95% H-UCL (Log ROS)	65.21		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.038	KM Geo Mean	2.823
KM SD (logged)	1.375	95% Critical H Value (KM-Log)	3.538
KM Standard Error of Mean (logged)	0.477	95% H-UCL (KM -Log)	29.61
KM SD (logged)	1.375	95% Critical H Value (KM-Log)	3.538
KM Standard Error of Mean (logged)	0.477		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	8.15	Mean in Log Scale	1.236
SD in Original Scale	12.67	SD in Log Scale	1.336
95% t UCL (Assumes normality)	14.41	95% H-Stat UCL	31.94

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use
95% KM (t) UCL 14.56

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

COPC (benzene)

General Statistics

Total Number of Observations	13	Number of Distinct Observations	6
Number of Detects	4	Number of Non-Detects	9
Number of Distinct Detects	4	Number of Distinct Non-Detects	2
Minimum Detect	0.11	Minimum Non-Detect	0.5
Maximum Detect	0.24	Maximum Non-Detect	5
Variance Detects	0.00449	Percent Non-Detects	69.23%
Mean Detects	0.173	SD Detects	0.067
Median Detects	0.17	CV Detects	0.389
Skewness Detects	0.0573	Kurtosis Detects	-5.453
Mean of Logged Detects	-1.817	SD of Logged Detects	0.403

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.836	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.283	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	0.173	KM Standard Error of Mean	0.0335
KM SD	0.058	95% KM (BCA) UCL	N/A
95% KM (t) UCL	0.232	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.228	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.273	95% KM Chebyshev UCL	0.319
97.5% KM Chebyshev UCL	0.382	99% KM Chebyshev UCL	0.506

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.512	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.658	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.311	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.395	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	8.519	k star (bias corrected MLE)	2.296
Theta hat (MLE)	0.0202	Theta star (bias corrected MLE)	0.0751
nu hat (MLE)	68.15	nu star (bias corrected)	18.37
Mean (detects)	0.173		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.077	Mean	0.173
Maximum	0.29	Median	0.169
SD	0.0636	CV	0.367
k hat (MLE)	7.654	k star (bias corrected MLE)	5.939
Theta hat (MLE)	0.0226	Theta star (bias corrected MLE)	0.0292
nu hat (MLE)	199	nu star (bias corrected)	154.4
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (154.42, α)	126.7	Adjusted Chi Square Value (154.42, β)	123.1
95% Gamma Approximate UCL (use when n>=50)	0.211	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	0.173	SD (KM)	0.058
Variance (KM)	0.00337	SE of Mean (KM)	0.0335
k hat (KM)	8.833	k star (KM)	6.846
nu hat (KM)	229.7	nu star (KM)	178
theta hat (KM)	0.0195	theta star (KM)	0.0252
80% gamma percentile (KM)	0.224	90% gamma percentile (KM)	0.261
95% gamma percentile (KM)	0.293	99% gamma percentile (KM)	0.362

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (177.99, α)	148.1	Adjusted Chi Square Value (177.99, β)	144.3
95% Gamma Approximate KM-UCL (use when n>=50)	0.207	95% Gamma Adjusted KM-UCL (use when n<50)	0.213

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.833	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.274	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.375	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.174	Mean in Log Scale	-1.817
SD in Original Scale	0.0657	SD in Log Scale	0.381
95% t UCL (assumes normality of ROS data)	0.206	95% Percentile Bootstrap UCL	0.203
95% BCA Bootstrap UCL	0.205	95% Bootstrap t UCL	0.211
95% H-UCL (Log ROS)	0.217		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	-1.817	KM Geo Mean	0.162
KM SD (logged)	0.349	95% Critical H Value (KM-Log)	1.953
KM Standard Error of Mean (logged)	0.202	95% H-UCL (KM -Log)	0.21
KM SD (logged)	0.349	95% Critical H Value (KM-Log)	1.953
KM Standard Error of Mean (logged)	0.202		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.611	Mean in Log Scale	-0.102

SD in Original Scale	1.171	SD in Log Scale	1.36
95% t UCL (Assumes normality)	2.19	95% H-Stat UCL	9.034

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 0.232

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

COPC (cis-1,2-dichloroethene)

General Statistics

Total Number of Observations	13	Number of Distinct Observations	8
Number of Detects	6	Number of Non-Detects	7
Number of Distinct Detects	6	Number of Distinct Non-Detects	2
Minimum Detect	1.7	Minimum Non-Detect	0.5
Maximum Detect	14	Maximum Non-Detect	5
Variance Detects	23.96	Percent Non-Detects	53.85%
Mean Detects	6.85	SD Detects	4.895
Median Detects	6.45	CV Detects	0.715
Skewness Detects	0.415	Kurtosis Detects	-1.532
Mean of Logged Detects	1.658	SD of Logged Detects	0.846

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.913	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.227	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.325	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	4.192	KM Standard Error of Mean	1.286
KM SD	4.019	95% KM (BCA) UCL	6.281
95% KM (t) UCL	6.484	95% KM (Percentile Bootstrap) UCL	6.323
95% KM (z) UCL	6.308	95% KM Bootstrap t UCL	6.485
90% KM Chebyshev UCL	8.05	95% KM Chebyshev UCL	9.798
97.5% KM Chebyshev UCL	12.22	99% KM Chebyshev UCL	16.99

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.331	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.704	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.238	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.336	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.027	k star (bias corrected MLE)	1.125
Theta hat (MLE)	3.379	Theta star (bias corrected MLE)	6.09

nu hat (MLE)	24.33	nu star (bias corrected)	13.5
Mean (detects)	6.85		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	4.077
Maximum	14	Median	2.5
SD	4.373	CV	1.073
k hat (MLE)	0.455	k star (bias corrected MLE)	0.401
Theta hat (MLE)	8.958	Theta star (bias corrected MLE)	10.16
nu hat (MLE)	11.83	nu star (bias corrected)	10.44
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (10.44, α)	4.216	Adjusted Chi Square Value (10.44, β)	3.67
95% Gamma Approximate UCL (use when n>=50)	10.09	95% Gamma Adjusted UCL (use when n<50)	11.59

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	4.192	SD (KM)	4.019
Variance (KM)	16.16	SE of Mean (KM)	1.286
k hat (KM)	1.088	k star (KM)	0.888
nu hat (KM)	28.29	nu star (KM)	23.09
theta hat (KM)	3.854	theta star (KM)	4.72
80% gamma percentile (KM)	6.807	90% gamma percentile (KM)	9.938
95% gamma percentile (KM)	13.1	99% gamma percentile (KM)	20.51

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (23.09, α)	13.16	Adjusted Chi Square Value (23.09, β)	12.1
95% Gamma Approximate KM-UCL (use when n>=50)	7.356	95% Gamma Adjusted KM-UCL (use when n<50)	7.999

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.924	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.238	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	4.239	Mean in Log Scale	1.026
SD in Original Scale	4.15	SD in Log Scale	0.963
95% t UCL (assumes normality of ROS data)	6.291	95% Percentile Bootstrap UCL	6.232
95% BCA Bootstrap UCL	6.688	95% Bootstrap t UCL	7.195
95% H-UCL (Log ROS)	9.609		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.956	KM Geo Mean	2.601
KM SD (logged)	1.032	95% Critical H Value (KM-Log)	2.904
KM Standard Error of Mean (logged)	0.401	95% H-UCL (KM -Log)	10.53
KM SD (logged)	1.032	95% Critical H Value (KM-Log)	2.904
KM Standard Error of Mean (logged)	0.401		

DL/2 Statistics

APPENDIX C
GROUNDWATER PROUCL Output
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	4.335	Mean in Log Scale	1.081
SD in Original Scale	4.028	SD in Log Scale	0.993
95% t UCL (Assumes normality)	6.326	95% H-Stat UCL	10.88

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use
95% KM (t) UCL 6.484

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

COPC (methyl tert-butyl ether)

General Statistics

Total Number of Observations	13	Number of Distinct Observations	6
Number of Detects	4	Number of Non-Detects	9
Number of Distinct Detects	4	Number of Distinct Non-Detects	2
Minimum Detect	0.59	Minimum Non-Detect	0.5
Maximum Detect	30	Maximum Non-Detect	5
Variance Detects	247.6	Percent Non-Detects	69.23%
Mean Detects	14.45	SD Detects	15.74
Median Detects	13.6	CV Detects	1.089
Skewness Detects	0.0544	Kurtosis Detects	-5.672
Mean of Logged Detects	1.578	SD of Logged Detects	2.044

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.799	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.3	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	4.898	KM Standard Error of Mean	3.168
KM SD	9.886	95% KM (BCA) UCL	N/A
95% KM (t) UCL	10.54	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	10.11	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	14.4	95% KM Chebyshev UCL	18.71
97.5% KM Chebyshev UCL	24.68	99% KM Chebyshev UCL	36.42

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.547	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.678	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.321	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.409	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.57	k star (bias corrected MLE)	0.309
Theta hat (MLE)	25.34	Theta star (bias corrected MLE)	46.73
nu hat (MLE)	4.561	nu star (bias corrected)	2.474
Mean (detects)	14.45		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	5.085
Maximum	30	Median	0.01
SD	10.36	CV	2.037
k hat (MLE)	0.212	k star (bias corrected MLE)	0.215
Theta hat (MLE)	23.96	Theta star (bias corrected MLE)	23.7
nu hat (MLE)	5.519	nu star (bias corrected)	5.578
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (5.58, α)	1.428	Adjusted Chi Square Value (5.58, β)	1.153
95% Gamma Approximate UCL (use when n>=50)	19.86	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	4.898	SD (KM)	9.886
Variance (KM)	97.73	SE of Mean (KM)	3.168
k hat (KM)	0.245	k star (KM)	0.24
nu hat (KM)	6.382	nu star (KM)	6.243
theta hat (KM)	19.95	theta star (KM)	20.4
80% gamma percentile (KM)	7.008	90% gamma percentile (KM)	14.74
95% gamma percentile (KM)	23.99	99% gamma percentile (KM)	48.76

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (6.24, α)	1.765	Adjusted Chi Square Value (6.24, β)	1.448
95% Gamma Approximate KM-UCL (use when n>=50)	17.32	95% Gamma Adjusted KM-UCL (use when n<50)	21.11

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.825	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.294	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	4.752	Mean in Log Scale	-1.035
SD in Original Scale	10.37	SD in Log Scale	2.599
95% t UCL (assumes normality of ROS data)	9.878	95% Percentile Bootstrap UCL	9.311
95% BCA Bootstrap UCL	11.12	95% Bootstrap t UCL	71.63
95% H-UCL (Log ROS)	994.4		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.146	KM Geo Mean	1.157
KM SD (logged)	1.398	95% Critical H Value (KM-Log)	3.583
KM Standard Error of Mean (logged)	0.469	95% H-UCL (KM -Log)	13.05
KM SD (logged)	1.398	95% Critical H Value (KM-Log)	3.583
KM Standard Error of Mean (logged)	0.469		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	5.83	Mean in Log Scale	0.766
SD in Original Scale	9.916	SD in Log Scale	1.432
95% t UCL (Assumes normality)	10.73	95% H-Stat UCL	27.06

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics
Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use
95% KM (t) UCL 10.54

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

COPC (tetrachloroethene)

General Statistics

Total Number of Observations	13	Number of Distinct Observations	10
Number of Detects	9	Number of Non-Detects	4
Number of Distinct Detects	8	Number of Distinct Non-Detects	2
Minimum Detect	0.59	Minimum Non-Detect	0.5
Maximum Detect	600	Maximum Non-Detect	5
Variance Detects	55853	Percent Non-Detects	30.77%
Mean Detects	152.2	SD Detects	236.3
Median Detects	12	CV Detects	1.553
Skewness Detects	1.394	Kurtosis Detects	0.355
Mean of Logged Detects	2.985	SD of Logged Detects	2.599

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.695	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.363	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.274	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	105.7	KM Standard Error of Mean	58.27
KM SD	198.1	95% KM (BCA) UCL	189.5
95% KM (t) UCL	209.6	95% KM (Percentile Bootstrap) UCL	199.5
95% KM (z) UCL	201.6	95% KM Bootstrap t UCL	407.6
90% KM Chebyshev UCL	280.5	95% KM Chebyshev UCL	359.7
97.5% KM Chebyshev UCL	469.6	99% KM Chebyshev UCL	685.5

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.487	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.801	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.224	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.3	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.332	k star (bias corrected MLE)	0.296
Theta hat (MLE)	457.9	Theta star (bias corrected MLE)	514.8
nu hat (MLE)	5.983	nu star (bias corrected)	5.322
Mean (detects)	152.2		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	105.4
Maximum	600	Median	3.6
SD	206.4	CV	1.958
k hat (MLE)	0.186	k star (bias corrected MLE)	0.194
Theta hat (MLE)	567.4	Theta star (bias corrected MLE)	542.8
nu hat (MLE)	4.829	nu star (bias corrected)	5.048
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (5.05, α)	1.174	Adjusted Chi Square Value (5.05, β)	0.933
95% Gamma Approximate UCL (use when n>=50)	453	95% Gamma Adjusted UCL (use when n<50)	570.1

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	105.7	SD (KM)	198.1
Variance (KM)	39233	SE of Mean (KM)	58.27
k hat (KM)	0.285	k star (KM)	0.27
nu hat (KM)	7.409	nu star (KM)	7.033
theta hat (KM)	371	theta star (KM)	390.9
80% gamma percentile (KM)	157.6	90% gamma percentile (KM)	315.3
95% gamma percentile (KM)	499.7	99% gamma percentile (KM)	985.4

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (7.03, α)	2.188	Adjusted Chi Square Value (7.03, β)	1.824
95% Gamma Approximate KM-UCL (use when n>=50)	339.8	95% Gamma Adjusted KM-UCL (use when n<50)	407.6

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.924	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.152	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.274	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	105.6	Mean in Log Scale	1.638
SD in Original Scale	206.2	SD in Log Scale	3.138
95% t UCL (assumes normality of ROS data)	207.6	95% Percentile Bootstrap UCL	203.9
95% BCA Bootstrap UCL	244.4	95% Bootstrap t UCL	408.8
95% H-UCL (Log ROS)	501509		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	2.003	KM Geo Mean	7.408
KM SD (logged)	2.549	95% Critical H Value (KM-Log)	5.971
KM Standard Error of Mean (logged)	0.764	95% H-UCL (KM -Log)	15423

KM SD (logged)	2.549	95% Critical H Value (KM-Log)	5.971
KM Standard Error of Mean (logged)	0.764		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	106	Mean in Log Scale	2.172
SD in Original Scale	206	SD in Log Scale	2.54
95% t UCL (Assumes normality)	207.8	95% H-Stat UCL	17310

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM Bootstrap t UCL	406.8	95% Hall's Bootstrap	15423

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

COPC (trichloroethene)

General Statistics

Total Number of Observations	13	Number of Distinct Observations	10
Number of Detects	10	Number of Non-Detects	3
Number of Distinct Detects	8	Number of Distinct Non-Detects	2
Minimum Detect	1.3	Minimum Non-Detect	0.5
Maximum Detect	150	Maximum Non-Detect	5
Variance Detects	3324	Percent Non-Detects	23.08%
Mean Detects	41.41	SD Detects	57.65
Median Detects	8.4	CV Detects	1.392
Skewness Detects	1.17	Kurtosis Detects	-0.495
Mean of Logged Detects	2.542	SD of Logged Detects	1.732

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.691	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.401	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	32.05	KM Standard Error of Mean	14.89
KM SD	50.92	95% KM (BCA) UCL	59.35
95% KM (t) UCL	58.58	95% KM (Percentile Bootstrap) UCL	56.75
95% KM (z) UCL	56.54	95% KM Bootstrap t UCL	67.95
90% KM Chebyshev UCL	76.71	95% KM Chebyshev UCL	96.94
97.5% KM Chebyshev UCL	125	99% KM Chebyshev UCL	180.2

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.917	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.774	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.321	**Kolmogorov-Smirnov GOF**

5% K-S Critical Value	0.28	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.532	k star (bias corrected MLE)	0.439
Theta hat (MLE)	77.77	Theta star (bias corrected MLE)	94.24
nu hat (MLE)	10.65	nu star (bias corrected)	8.788
Mean (detects)	41.41		

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	31.86
Maximum	150	Median	7.6
SD	53.13	CV	1.668
k hat (MLE)	0.273	k star (bias corrected MLE)	0.261
Theta hat (MLE)	116.8	Theta star (bias corrected MLE)	122
nu hat (MLE)	7.09	nu star (bias corrected)	6.787
Adjusted Level of Significance (β)	0.0301		
Approximate Chi Square Value (6.79, α)	2.054	Adjusted Chi Square Value (6.79, β)	1.705
95% Gamma Approximate UCL (use when n>=50)	105.2	95% Gamma Adjusted UCL (use when n<50)	126.8

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	32.05	SD (KM)	50.92
Variance (KM)	2593	SE of Mean (KM)	14.89
k hat (KM)	0.396	k star (KM)	0.356
nu hat (KM)	10.3	nu star (KM)	9.257
theta hat (KM)	80.9	theta star (KM)	90.02
80% gamma percentile (KM)	50.9	90% gamma percentile (KM)	92.31
95% gamma percentile (KM)	138.6	99% gamma percentile (KM)	256.4

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (9.26, α)	3.483	Adjusted Chi Square Value (9.26, β)	2.996
95% Gamma Approximate KM-UCL (use when n>=50)	85.19	95% Gamma Adjusted KM-UCL (use when n<50)	99.02

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.874	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.233	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.262	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	32	Mean in Log Scale	1.775
SD in Original Scale	53.03	SD in Log Scale	2.132
95% t UCL (assumes normality of ROS data)	58.22	95% Percentile Bootstrap UCL	56.26
95% BCA Bootstrap UCL	62.8	95% Bootstrap t UCL	68.35
95% H-UCL (Log ROS)	1317		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	1.894	KM Geo Mean	6.643

KM SD (logged)	1.879	95% Critical H Value (KM-Log)	4.509
KM Standard Error of Mean (logged)	0.553	95% H-UCL (KM -Log)	447.7
KM SD (logged)	1.879	95% Critical H Value (KM-Log)	4.509
KM Standard Error of Mean (logged)	0.553		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	32.26	Mean in Log Scale	1.99
SD in Original Scale	52.87	SD in Log Scale	1.909
95% t UCL (Assumes normality)	58.39	95% H-Stat UCL	564.9

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL	125	99% KM (Chebyshev) UCL	180.2

Warning: Recommended UCL exceeds the maximum observation

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Appendix D

Appendix D

Shower Model – Input Assumptions and Estimated Air Concentrations

TABLE D-1
VALUES USED FOR SHOWER MODEL
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Air
Receptor Population:	Resident
Receptor Age:	Adult

Exposure Route	Parameter Code	Parameter Definition	Unit	Reasonable Maximum Exposure		Central Tendency Exposure		Intake Equation/ Model Name
				Value	Reference	Value	Reference	
Inhalation	CW	Chemical Concentration in Water	µg/L	Table B-3	Table B-3	Table B-3	Table B-3	Maximum air concentration in bathroom
	f	Fraction volatilized	--	chem-specific	Schaum et al. (1)	chem-specific	Schaum et al. (1)	(C_{aMax}) (µg/m^3) =
	F_w	Flow Rate	L/hr	1000	Schaum et al.	500	Schaum et al.	CW x f x Fw x t_1 x 1/Va
	t_1	Time of shower	hr	0.50	EPA 2011(2)	0.23	EPA 2011(3)	
	V_a	Bathroom volume	m^3	6	Schaum et al.	16	Schaum et al.	EPC (µg/m^3) =
	t_2	Time after shower in bathroom	hr	0.33	EPA 2011(2)	0.08	EPA 2011(3)	(((C_{aMax}2) x t_1) + (C_{aMax} x t_2)) / (t_1 + t_2)

EPC = Exposure Point Concentration, the average air concentration in the bathroom during and after shower
µg = microgram
L = liter
hr = hour
m = meter
Note:
(1) applies only to volatile chemicals
(2) based on the weighted average of 90th percentile duration of shower and duration in shower immediately following a shower (Table 16-32)
(3) based on the weighted average of 50th percentile duration of shower and duration in shower immediately following a shower (Table 16-32)
Sources:
EPA 2011. Exposure Factors Handbook: 2011 Edition. EPA/600/R-090/052F. September.
Schaum *et al*. 1994. *Estimating Dermal and Inhalation Exposure to Volatile Chemicals in Domestic Water*. Water Contamination and Health, edited by Rhoda G.M. Wang. New York: Marcel Dekker, Inc.

TABLE D-2
VALUES USED FOR SHOWER MODEL
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Air
Receptor Population:	Resident
Receptor Age:	Child (birth to <6 years)

Exposure Route	Parameter Code	Parameter Definition	Unit	Reasonable Maximum Exposure		Central Tendency Exposure		Intake Equation/ Model Name
				Value	Reference	Value	Reference	
Inhalation	CW	Chemical Concentration in Water	µg/L	chemical specific	Table B-3	chemical specific	Table B-3	Maximum air concentration in bathroom
	f	Fraction volatilized	--	chemical specific	Schaum et al. (1)	chemical specific	Schaum et al. (1)	(C_{aMax}) (µg/m^3) =
	F_w	Flow Rate	L/hr	1000	Schaum et al.	500	Schaum et al.	CW x f x Fw x t_1 x 1/Va
	t_1	Time of shower	hr	0.50	EPA 2011(2)	0.30	EPA 2011(3)	
	V_a	Bathroom volume	m^3	6	Schaum et al.	16	Schaum et al.	EPC (µg/m^3) =
	t_2	Time after shower in bathroom	hr	0.23	EPA 2011(2)	0.1	EPA 2011(3)	(((C_{aMax}2) x t_1) + (C_{aMax} x t_2)) / (t_1 + t_2)

EPC = Exposure Point Concentration, the average air concentration in the bathroom during and after shower
µg = microgram
L = liter
hr = hour
m = meter
Note:
(1) applies only to volatile chemicals
(2) based on the weighted average of 90th percentile duration of shower and duration in shower immediately following a shower (Table 16-29)
(3) based on the weighted average of mean duration of shower and duration in shower immediately following a shower (Table 16-29)
Sources:
EPA 2011. Exposure Factors Handbook: 2011 Edition. EPA/600/R-090/052F. September.
Schaum *et al* . 1994. *Estimating Dermal and Inhalation Exposure to Volatile Chemicals in Domestic Water* . Water Contamination and Health, edited by Rhoda G.M. Wang. New York: Marcel Dekker, Inc.

TABLE D-3

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Air
Receptor Population:	Resident
Receptor Age:	Adult

Exposure Point	CAS No.	Chemical of Potential Concern	Groundwater Exposure Point Concentration (EPC) (µg/L)	Fraction Volatilized	Reasonable Maximum Exposure		Central Tendency Exposure	
					C_{aMax} (µg/m^3)	Air EPC (µg/m^3)	C_{aMax} (µg/m^3)	Air EPC (µg/m^3)
Water Vapor at Showerhead		**Volatile Organic Compounds**						
	75-34-3	1,1-Dichloroethane	1.2E+01	5.4E-01	5.3E+02	3.7E+02	4.6E+01	2.9E+01
	75-35-4	1,1-Dichloroethene	1.5E+01	5.5E-01	6.7E+02	4.7E+02	5.8E+01	3.6E+01
	71-43-2	Benzene	2.3E-01	5.3E-01	1.0E+01	7.1E+00	8.8E-01	5.6E-01
	56-23-5	Carbon Tetrachloride	4.9E-01	5.1E-01	2.1E+01	1.5E+01	1.8E+00	1.1E+00
	67-66-3	Chloroform	1.0E+00	5.5E-01	4.6E+01	3.2E+01	4.0E+00	2.5E+00
	156-59-2	cis-1,2-Dichloroethene	6.5E+00	5.6E-01	3.0E+02	2.1E+02	2.6E+01	1.7E+01
	100-41-4	Ethylbenzene	2.8E+00	4.6E-01	1.1E+02	7.6E+01	9.3E+00	5.9E+00
	1634-04-4	Methyl Tert-Butyl Ether	1.1E+01	4.7E-01	4.1E+02	2.9E+02	3.5E+01	2.2E+01
	127-18-4	Tetrachloroethene	4.1E+02	5.0E-01	1.7E+04	1.2E+04	1.5E+03	9.2E+02
	79-01-6	Trichloroethene	1.3E+02	5.3E-01	5.5E+03	3.8E+03	4.7E+02	3.0E+02
	75-01-4	Vinyl Chloride	9.1E+00	5.9E-01	4.4E+02	3.1E+02	3.8E+01	2.4E+01

EPC = Exposure Point Concentration, the average air concentration in the bathroom during and after shower

µg/L = microgram per liter

µg/m^3 = microgram per cubic meter

TABLE D-4

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Scenario Timeframe:	Future
Medium:	Groundwater
Exposure Medium:	Air
Receptor Population:	Resident
Receptor Age:	Child (birth to <6 years)

Exposure Point	CAS No.	Chemical of Potential Concern	Groundwater Exposure Point Concentration (EPC) (µg/L)	Fraction Volatilized	Reasonable Maximum Exposure		Central Tendency Exposure	
					C_{aMax} (µg/m^3)	Air EPC (µg/m^3)	C_{aMax} (µg/m^3)	Air EPC (µg/m^3)
Water Vapor at Showerhead		**Volatile Organic Compounds**						
	75-34-3	1,1-Dichloroethane	1.2E+01	5.4E-01	5.3E+02	3.5E+02	6.0E+01	3.7E+01
	75-35-4	1,1-Dichloroethene	1.5E+01	5.5E-01	6.7E+02	4.4E+02	7.5E+01	4.7E+01
	71-43-2	Benzene	2.3E-01	5.3E-01	1.0E+01	6.7E+00	1.2E+00	7.2E-01
	56-23-5	Carbon Tetrachloride	4.9E-01	5.1E-01	2.1E+01	1.4E+01	2.3E+00	1.5E+00
	67-66-3	Chloroform	1.0E+00	5.5E-01	4.6E+01	3.0E+01	5.2E+00	3.2E+00
	156-59-2	cis-1,2-Dichloroethene	6.5E+00	5.6E-01	3.0E+02	2.0E+02	3.4E+01	2.1E+01
	100-41-4	Ethylbenzene	2.8E+00	4.6E-01	1.1E+02	7.1E+01	1.2E+01	7.6E+00
	1634-04-4	Methyl Tert-Butyl Ether	1.1E+01	4.7E-01	4.1E+02	2.7E+02	4.6E+01	2.9E+01
	127-18-4	Tetrachloroethene	4.1E+02	5.0E-01	1.7E+04	1.1E+04	1.9E+03	1.2E+03
	79-01-6	Trichloroethene	1.3E+02	5.3E-01	5.5E+03	3.6E+03	6.2E+02	3.9E+02
	75-01-4	Vinyl Chloride	9.1E+00	5.9E-01	4.4E+02	2.9E+02	5.0E+01	3.1E+01

EPC = Exposure Point Concentration, the average air concentration in the bathroom during and after shower

µg/L = microgram per liter

µg/m^3 = microgram per cubic meter

Appendix E

Appendix E

Vapor Intrusion Screening

Table E-1 Comparison of Maximum Detected Concentrations to Vapor Intrusion Screening Levels

TABLE E-1

COMPARISON OF MAXIMUM DETECTED CONCENTRATIONS TO VAPOR INTRUSION SCREENING LEVELS

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Exposure Point	CAS No.	Chemical	Minimum Concentration (Qualifier)	Maximum Concentration (Qualifier)	Unit	Location of Maximum Concentration	Detection Frequency	Range of Reporting Limit	Concentration Used for Screening [1]	Screening Toxicity Value (n/c) [2]	COPC Flag (Yes/No)
	71-55-6	1,1,1-Trichloroethane	0.67 J	18 J	µg/L	SVP/GWM-6	5 / 13	0.5 - 5	18	742	No
	76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane	6	6.6	µg/L	SVP/GWM-3	3 / 13	0.5 - 5	6.6	145	No
	75-34-3	**1,1-Dichloroethane**	**0.86 J**	**24 J**	**µg/L**	**SVP/GWM-6**	**7 / 13**	**0.5 - 5**	**24**	**7.64**	**Yes**
	75-35-4	**1,1-Dichloroethene**	**1.3 J**	**44 J+**	**µg/L**	**SVP/GWM-6**	**6 / 13**	**0.5 - 5**	**44**	**19.5**	**Yes**
	107-06-2	1,2-Dichloroethane	0.14 J	0.14 J	µg/L	SVP/GWM-6	1 / 13	0.5 - 5	0.14	2.24	No
	106-46-7	1,4-Dichlorobenzene	0.17 J	0.17 J	µg/L	MW-15	1 / 13	0.5 - 5	0.17	2.59	No
	78-93-3	2-Butanone	3.8 J	3.8 J	µg/L	SVP/GWM-14	1 / 13	5 - 10	3.8	224155	No
	67-64-1	Acetone	4.6 J	17 J	µg/L	MW-3	2 / 13	5 - 10	17	2259317	No
	71-43-2	**Benzene**	**0.11 J**	**0.24 J**	**µg/L**	**SVP/GWM-6**	**4 / 13**	**0.5 - 5**	**0.24**	**1.59**	**Yes**
	56-23-5	**Carbon Tetrachloride**	**0.16 J**	**0.49 J**	**µg/L**	**SVP/GWM-6**	**3 / 13**	**0.5 - 5**	**0.49**	**0.41**	**Yes**
	67-66-3	**Chloroform**	**0.53 J**	**1**	**µg/L**	**MW-18**	**2 / 13**	**0.5 - 5**	**1**	**0.81**	**Yes**
	156-59-2	cis-1,2-Dichloroethene	1.7 J	14 J+	µg/L	SVP/GWM-6	6 / 13	0.5 - 5	14	NA	No
	75-71-8	**Dichlorodifluoromethane**	**0.5 J**	**9.4**	**µg/L**	**MW-2**	**2 / 13**	**0.5 - 5**	**9.4**	**0.74**	**Yes**
	100-41-4	Ethylbenzene	1.5	2.8 J	µg/L	MW-3	2 / 13	0.5 - 5	2.8	3.49	No
	179601-23-1	m,p-Xylene	0.11 J	14 J	µg/L	MW-3	3 / 13	0.5 - 5	14	35.5 [3]	No
	1634-04-4	Methyl Tert-Butyl Ether	0.59 J	30	µg/L	SVP/GWM-3	4 / 13	0.5 - 5	30	450	No
	95-47-6	o-Xylene	0.17 J	9.1 J	µg/L	MW-3	2 / 13	0.5 - 5	9.1	49.2	No
	127-18-4	**Tetrachloroethene**	**0.59 J**	**600**	**µg/L**	**MW-16**	**9 / 13**	**0.5 - 50**	**600**	**5.76**	**Yes**
	108-88-3	Toluene	0.09 J	0.38 J	µg/L	MW-3	3 / 13	0.5 - 5	0.38	1921	No
	156-60-5	trans-1,2-Dichloroethene	0.33 J	0.33 J	µg/L	SVP/GWM-6	1 / 13	0.5 - 5	0.33	NA	No
	79-01-6	**Trichloroethene**	**1.3 J**	**150**	**µg/L**	**SVP/GWM-13**	**10 / 13**	**0.5 - 20**	**150**	**0.52**	**Yes**
	75-69-4	Trichlorofluoromethane	2	140	µg/L	SVP/GWM-3	3 / 13	0.5 - 25	140	NA	No
	75-01-4	**Vinyl Chloride**	**9.1 J**	**9.1 J**	**µg/L**	**SVP/GWM-6**	**1 / 13**	**0.5 - 5**	**9.1**	**0.15**	**Yes**

[1] Maximum detected concentration used for screening

[2] Screened against Vapor Intrusion Screening Level (VISL) Calculator Version 3.5.1 (May 2016 RSLs) for residential scenario with target risk of 1×10^{-6} and hazard quotient of 0.1.

[3] screening value for m-xylene

NA = not available

COPC = chemical of potential concern

J = qualifier for estimated value

J+ = qualifier for estimated value

µg/L = micrograms per liter

CDM Smith

Appendix F

Appendix F

RAGS D Tables for Central Tendency Exposure Scenario

TABLE F-1.0

CALCULATION OF CHEMICAL CANCER RISKS AND NONCANCER HAZARDS - TRICHLOROETHYLENE

GROUNDWATER FOR FUTURE RESIDENT

CENTRAL TENDENCY EXPOSURE

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Common Exposure Parameters

Groundwater Concentration (CW)	125	µg/L	
Exposure Frequency	350	days	
Permeability Coefficient	0.012	cm/hr	(Table B-4.2)
Fraction Absorbed Water	1		(Table B-4.2)
Lag time	0.58	hr/day	(Table B-4.2)
Exposure Time - child	0.38	hr/day	(Table B-4.1a)
Exposure Time - adult	0.36	hr/day	(Table B-4.1a)

Ingestion

	Exposure Parameters					Cancer Risk Calculations						
C1	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*	*C8*	*C9*	*C10*	*C11*	*C12*	*C13*
Unit	kg	L/day	mg/L	yr	-	$(mg/kg/d)^{-1}$	-	-	$(mg/kg/d)^{-1}$	$(mg/kg/d)^{-1}$	-	-
Equation	-	-	CW/1000	-	*(C5 / 70 yr x EF / 365 days)*	-	-	*(C3 x C4 x C6 x C7 x C8 / C2)*	-	*(C10 − C7)*	*(C3 x C4 x C6 x C11 / C2)*	*(C9 + C12)*
Age group	Body Weight	Ingestion Rate	Exposure Concentration	Age Group Duration	Duration Adjustment	Kidney Slope Factor	Kidney Cancer ADAF	**Kidney ADAF-Adjusted Partial Risk**	Kidney+NHL+ Liver Slope Factor	NHL+Liver Slope Factor	**NHL+Liver Partial Risk**	**Total Partial Risk**
0 to <2 years	15	0.39	0.125	2	2.7E-02	9.3E-03	10	**8.3E-06**	4.6E-02	3.7E-02	**3.3E-06**	**1.2E-05**
2 to <6 years	15	0.39	0.125	4	5.5E-02	9.3E-03	3	**5.0E-06**	4.6E-02	3.7E-02	**6.5E-06**	**1.2E-05**
18 to <21 years	80	1	0.125	3	4.1E-02	9.3E-03	1	**6.0E-07**	4.6E-02	3.7E-02	**2.4E-06**	**3.0E-06**
										Total Ingestion Risk		**2.6E-05**

Dermal Contact

	Exposure Parameters					Cancer Risk Calculations						
C1	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*	*C8*	*C9*	*C10*	*C11*	*C12*	*C13*
Unit	kg	cm^2/day	mg/cm^2	yr	-	$(mg/kg/d)^{-1}$	-	-	$(mg/kg/d)^{-1}$	$(mg/kg/d)^{-1}$	-	-
Equation	-	-	*Table B-4.2*	-	*(C5 / 70 yr x EF / 365 days)*	-	-	*(C3 x C4 x C6 x C7 x C8 / C2)*	-	*(C10 − C7)*	*(C3 x C4 x C6 x C11 / C2)*	*(C9 + C12)*
Age group	Body Weight	Skin Surface Area	Dermal Absorbed (DA_{event})	Age Group Duration	Duration Adjustment	Kidney Slope Factor	Kidney Cancer ADAF	**Kidney ADAF-Adjusted Partial Risk**	Kidney+NHL+ Liver Slope Factor	NHL+Liver Slope Factor	**NHL+Liver Partial Risk**	**Total Partial Risk**
0 to <2 years	15	6,378	1.9E-06	2	2.7E-02	9.3E-03	10	**2.1E-06**	4.6E-02	3.7E-02	**8.2E-07**	**2.9E-06**
2 to <6 years	15	6,378	1.9E-06	4	5.5E-02	9.3E-03	3	**1.3E-06**	4.6E-02	3.7E-02	**1.6E-06**	**2.9E-06**
18 to <21 years	80	20,900	1.9E-06	3	4.1E-02	9.3E-03	1	**1.9E-07**	4.6E-02	3.7E-02	**7.6E-07**	**9.5E-07**
										Total Dermal Risk		**6.8E-06**

TABLE F-1.0

CALCULATION OF CHEMICAL CANCER RISKS AND NONCANCER HAZARDS - TRICHLOROETHYLENE

GROUNDWATER FOR FUTURE RESIDENT

CENTRAL TENDENCY EXPOSURE

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Inhalation of Volatile Chemicals

	Exposure Parameters					Cancer Risk Calculations						
C1	*C2*	*C3*	*C4*	*C5*	*C6*	*C7*	*C8*	*C9*	*C10*	*C11*	*C12*	*C13*
Unit	hr/day	$\mu g/m^3$	$\mu g/m^3$	yr	-	$(\mu g/m^3)^{-1}$	-	-	$(\mu g/m^3)^{-1}$	$(\mu g/m^3)^{-1}$	-	-
Equation	-	Table D-3/D-4	*C3*	-	*(C5 / 70 yr x C2 / 24 hrs x EF / 365 days)*	-	-	*(C4 x C6 x C7 x C8)*	-	*(C10 − C7)*	*(C4 x C6 x C11)*	*(C9 + C12)*
Age group	Exposure Time	Chemical Concentration in Air	Exposure Concentration	Age Group Duration	Duration Adjustment	Kidney Unit Risk	Kidney Cancer ADAF	**Kidney ADAF-Adjusted Partial Risk**	Kidney+NHL+ Liver Unit Risk	NHL+Liver Unit Risk	**NHL+Liver Partial Risk**	**Total Partial Risk**
0 to <2 years	0.38	3.9E+02	3.9E+02	2	4.3E-04	1.0E-06	10	**1.7E-06**	4.1E-06	3.1E-06	**5.2E-07**	**2.2E-06**
2 to <6 years	0.38	3.9E+02	3.9E+02	4	8.7E-04	1.0E-06	3	**1.0E-06**	4.1E-06	3.1E-06	**1.0E-06**	**2.0E-06**
18 to <21 years	0.36	3.0E+02	3.0E+02	3	6.2E-04	1.0E-06	1	**1.8E-07**	4.1E-06	3.1E-06	**5.7E-07**	**7.5E-07**
										Total Inhalation Risk		**5.0E-06**

ADAF = age-dependent adjustment factors

Source:

(1) EPA 2011. Toxicological Review of Trichloroethylene (CAS No. 79-01-6) in Support of Summary Information on the Integrated Risk Information System (IRIS). September

TABLE F-1.1
CALCULATION OF CHEMICAL CANCER RISKS AND NONCANCER HAZARDS
CENTRAL TENDENCY EXPOSURE
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Scenario Timeframe:	Future
Receptor Population:	Resident
Receptor Age:	Lifetime[1]

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Exposure Point Concentration		Cancer Risk Calculation					Noncancer Hazard Calculation				
							Intake/ Exposure Concentration		Slope Factor/Unit Risk		Cancer	Intake/ Exposure Concentration		RfD/RfC		Hazard
					Value	Unit	Value	Unit	Value	Unit	Risk	Value	Unit	Value	Unit	Quotient
Groundwater	Groundwater	Groundwater	Ingestion	**Volatile Organic Compounds**												
				1,1-Dichloroethane	1.18E+01	µg/L	3.13E-05	mg/kg-day	5.70E-03	$(mg/kg-day)^{-1}$	1.78E-07	2.94E-04	mg/kg-day	2.00E-01	mg/kg-day	1.47E-03
				1,1-Dichloroethene	1.46E+01	µg/L	3.86E-05	mg/kg-day	NA	NA	NA	3.63E-04	mg/kg-day	5.00E-02	mg/kg-day	7.26E-03
				Benzene	2.32E-01	µg/L	6.15E-07	mg/kg-day	5.50E-02	$(mg/kg-day)^{-1}$	3.38E-08	5.78E-06	mg/kg-day	4.00E-03	mg/kg-day	1.45E-03
				Carbon Tetrachloride	4.90E-01	µg/L	1.30E-06	mg/kg-day	7.00E-02	$(mg/kg-day)^{-1}$	9.09E-08	1.22E-05	mg/kg-day	4.00E-03	mg/kg-day	3.05E-03
				Chloroform	1.00E+00	µg/L	2.65E-06	mg/kg-day	3.10E-02	$(mg/kg-day)^{-1}$	8.22E-08	2.49E-05	mg/kg-day	1.00E-02	mg/kg-day	2.49E-03
				cis-1,2-Dichloroethene	6.48E+00	µg/L	1.72E-05	mg/kg-day	NA	NA	NA	1.62E-04	mg/kg-day	2.00E-03	mg/kg-day	8.08E-02
				Ethylbenzene	2.80E+00	µg/L	7.42E-06	mg/kg-day	1.10E-02	$(mg/kg-day)^{-1}$	8.16E-08	6.98E-05	mg/kg-day	1.00E-01	mg/kg-day	6.98E-04
				Methyl Tert-Butyl Ether	1.05E+01	µg/L	2.79E-05	mg/kg-day	1.80E-03	$(mg/kg-day)^{-1}$	5.03E-08	2.63E-04	mg/kg-day	NA	NA	NA
				Tetrachloroethene	4.07E+02	µg/L	1.08E-03	mg/kg-day	2.10E-03	$(mg/kg-day)^{-1}$	2.26E-06	1.01E-02	mg/kg-day	6.00E-03	mg/kg-day	1.69E+00
				Trichloroethene	1.25E+02	µg/L	See Table F-1.0	NA	4.60E-02	$(mg/kg-day)^{-1}$	2.60E-05	3.12E-03	mg/kg-day	5.00E-04	mg/kg-day	6.23E+00
				Vinyl Chloride	9.10E+00	µg/L	2.61E-04	mg/kg-day	7.20E-01	$(mg/kg-day)^{-1}$	1.88E-04	2.27E-04	mg/kg-day	3.00E-03	mg/kg-day	7.56E-02
				Inorganics												
				Arsenic	3.10E+00	µg/L	8.22E-06	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	1.23E-05	7.73E-05	mg/kg-day	3.00E-04	mg/kg-day	2.58E-01
				Chromium	8.90E+00	µg/L	2.36E-05	mg/kg-day	5.00E-01	$(mg/kg-day)^{-1}$	1.18E-05	2.22E-04	mg/kg-day	3.00E-03	mg/kg-day	7.40E-02
				Cobalt	6.90E+00	µg/L	1.83E-05	mg/kg-day	NA	NA	NA	1.72E-04	mg/kg-day	3.00E-04	mg/kg-day	5.73E-01
				Vanadium	9.10E+00	µg/L	2.41E-05	mg/kg-day	NA	NA	NA	2.27E-04	mg/kg-day	9.00E-03	mg/kg-day	2.52E-02
				Zinc	9.50E+02	µg/L	2.52E-03	mg/kg-day	NA	NA	NA	2.37E-02	mg/kg-day	3.00E-01	mg/kg-day	7.89E-02
			Exp. Route Total								2.41E-04					9.11E+00
Groundwater	Groundwater	Groundwater	Dermal	**Volatile Organic Compounds**												
			Contact	1,1-Dichloroethane	1.18E+01	µg/L	3.76E-06	mg/kg-day	5.70E-03	$(mg/kg-day)^{-1}$	2.15E-08	3.36E-05	mg/kg-day	2.00E-01	mg/kg-day	1.68E-04
				1,1-Dichloroethene	1.46E+01	µg/L	8.20E-06	mg/kg-day	NA	NA	NA	7.32E-05	mg/kg-day	5.00E-02	mg/kg-day	1.46E-03
				Benzene	2.32E-01	µg/L	1.45E-07	mg/kg-day	5.50E-02	$(mg/kg-day)^{-1}$	7.95E-09	1.29E-06	mg/kg-day	4.00E-03	mg/kg-day	3.23E-04
				Carbon Tetrachloride	4.90E-01	µg/L	5.34E-07	mg/kg-day	7.00E-02	$(mg/kg-day)^{-1}$	3.74E-08	4.77E-06	mg/kg-day	4.00E-03	mg/kg-day	1.19E-03
				Chloroform	1.00E+00	µg/L	3.71E-07	mg/kg-day	3.10E-02	$(mg/kg-day)^{-1}$	1.15E-08	3.31E-06	mg/kg-day	1.00E-02	mg/kg-day	3.31E-04
				cis-1,2-Dichloroethene	6.48E+00	µg/L	NA	NA	NA	NA	NA	NA	NA	2.00E-03	mg/kg-day	NA
				Ethylbenzene	2.80E+00	µg/L	6.86E-06	mg/kg-day	1.10E-02	$(mg/kg-day)^{-1}$	7.55E-08	6.12E-05	mg/kg-day	1.00E-01	mg/kg-day	6.12E-04
				Methyl Tert-Butyl Ether	1.05E+01	µg/L	NA	NA	1.80E-03	$(mg/kg-day)^{-1}$	NA	NA	NA	NA	NA	NA
				Tetrachloroethene	4.07E+02	µg/L	9.88E-04	mg/kg-day	2.10E-03	$(mg/kg-day)^{-1}$	2.07E-06	8.82E-03	mg/kg-day	6.00E-03	mg/kg-day	1.47E+00
				Trichloroethene	1.25E+02	µg/L	See Table F-1.0	NA	4.60E-02	$(mg/kg-day)^{-1}$	6.77E-06	7.87E-04	mg/kg-day	5.00E-04	mg/kg-day	1.57E+00
				Vinyl Chloride	9.10E+00	µg/L	1.99E-05	mg/kg-day	7.20E-01	$(mg/kg-day)^{-1}$	1.43E-05	1.72E-05	mg/kg-day	3.00E-03	mg/kg-day	5.73E-03
				Inorganics												
				Arsenic	3.10E+00	µg/L	5.29E-08	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	7.93E-08	4.72E-07	mg/kg-day	3.00E-04	mg/kg-day	1.57E-03
				Chromium	8.90E+00	µg/L	1.52E-07	mg/kg-day	5.00E-01	$(mg/kg-day)^{-1}$	7.59E-08	1.35E-06	mg/kg-day	7.50E-05	mg/kg-day	1.81E-02
				Cobalt	6.90E+00	µg/L	4.71E-08	mg/kg-day	NA	NA	NA	4.20E-07	mg/kg-day	3.00E-04	mg/kg-day	1.40E-03
				Vanadium	9.10E+00	µg/L	1.55E-07	mg/kg-day	NA	NA	NA	1.39E-06	mg/kg-day	2.34E-04	mg/kg-day	5.92E-03
				Zinc	9.50E+02	µg/L	9.72E-06	mg/kg-day	NA	NA	NA	8.68E-05	mg/kg-day	3.00E-01	mg/kg-day	2.89E-04
			Exp. Route Total								2.34E-05					3.08E+00

TABLE F-1.1
CALCULATION OF CHEMICAL CANCER RISKS AND NONCANCER HAZARDS
CENTRAL TENDENCY EXPOSURE
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Scenario Timeframe:	Future
Receptor Population:	Resident
Receptor Age:	Lifetime[1]

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Exposure Point Concentration		Cancer Risk Calculation					Noncancer Hazard Calculation				
							Intake/ Exposure Concentration		Slope Factor/Unit Risk		Cancer	Intake/ Exposure Concentration		RfD/RfC		Hazard
					Value	Unit	Value	Unit	Value	Unit	Risk	Value	Unit	Value	Unit	Quotient
Groundwater	Groundwater	Groundwater	Inhalation	**Volatile Organic Compounds**												
				1,1-Dichloroethane	1.18E+01	µg/L	6.63E-02	µg/m^3	1.60E-06	(µg/m^3)$^{-1}$	1.06E-07	5.67E-04	mg/m^3	NA	NA	NA
				1,1-Dichloroethene	1.46E+01	µg/L	8.38E-02	µg/m^3	NA	NA	NA	7.16E-04	mg/m^3	2.00E-01	mg/m^3	3.58E-03
				Benzene	2.32E-01	µg/L	1.28E-03	µg/m^3	7.80E-06	(µg/m^3)$^{-1}$	9.97E-09	1.09E-05	mg/m^3	3.00E-02	mg/m^3	3.64E-04
				Carbon Tetrachloride	4.90E-01	µg/L	2.61E-03	µg/m^3	6.00E-06	(µg/m^3)$^{-1}$	1.57E-08	2.23E-05	mg/m^3	1.00E-01	mg/m^3	2.23E-04
				Chloroform	1.00E+00	µg/L	5.72E-03	µg/m^3	2.30E-05	(µg/m^3)$^{-1}$	1.32E-07	4.89E-05	mg/m^3	3.00E-01	mg/m^3	1.63E-04
				cis-1,2-Dichloroethene	6.48E+00	µg/L	3.80E-02	µg/m^3	NA	NA	NA	3.25E-04	mg/m^3	NA	NA	NA
				Ethylbenzene	2.80E+00	µg/L	1.35E-02	µg/m^3	2.50E-06	(µg/m^3)$^{-1}$	3.38E-08	1.15E-04	mg/m^3	1.00E+00	mg/m^3	1.15E-04
				Methyl Tert-Butyl Ether	1.05E+01	µg/L	5.14E-02	µg/m^3	2.60E-07	(µg/m^3)$^{-1}$	1.34E-08	4.39E-04	mg/m^3	3.00E+00	mg/m^3	1.46E-04
				Tetrachloroethene	4.07E+02	µg/L	2.12E+00	µg/m^3	2.60E-07	(µg/m^3)$^{-1}$	5.50E-07	1.81E-02	mg/m^3	4.00E-02	mg/m^3	4.52E-01
				Trichloroethene	1.25E+02	µg/L	See Table F-1.0	NA	4.10E-06	(µg/m^3)$^{-1}$	4.98E-06	5.85E-03	mg/m^3	2.00E-03	mg/m^3	2.92E+00
				Vinyl Chloride	9.10E+00	µg/L	3.13E+01	µg/m^3	4.40E-06	(µg/m^3)$^{-1}$	1.38E-04	4.75E-04	mg/m^3	1.00E-01	mg/m^3	4.75E-03
			Exp. Route Total								1.44E-04					3.38E+00
		Exposure Point Total									4.08E-04					1.56E+01

NA = not applicable
RfD = reference dose
RfC = reference concentration
µg/L = microgram per liter
mg/kg-day = milligram per kilogram per day
µg/m^3 = microgram per cubic meter
mg/m^3 = milligram per cubic meter

[1] cancer risk is based on age-adjusted scenario and noncancer hazard index is based on child exposure scenario

TABLE F-1.2

CALCULATION OF CHEMICAL CANCER RISKS AND NONCANCER HAZARDS

CENTRAL TENDENCY EXPOSURE

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Scenario Timeframe:	Future
Receptor Population:	Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	Exposure Point Concentration		Cancer Risk Calculation					Noncancer Hazard Calculation				
							Intake/ Exposure Concentration		Slope Factor/Unit Risk		Cancer	Intake/ Exposure Concentration		RfD/RfC		Hazard
					Value	Unit	Value	Unit	Value	Unit	Risk	Value	Unit	Value	Unit	Quotient
Groundwater	Groundwater	Groundwater	Ingestion	**Volatile Organic Compounds**												
				1,1-Dichloroethane	1.18E+01	µg/L	1.14E-05	mg/kg-day	5.70E-03	$(mg/kg-day)^{-1}$	6.49E-08	8.86E-05	mg/kg-day	2.00E-01	mg/kg-day	4.43E-04
				1,1-Dichloroethene	1.46E+01	µg/L	1.40E-05	mg/kg-day	NA	NA	NA	1.09E-04	mg/kg-day	5.00E-02	mg/kg-day	2.18E-03
				Benzene	2.32E-01	µg/L	2.24E-07	mg/kg-day	5.50E-02	$(mg/kg-day)^{-1}$	1.23E-08	1.74E-06	mg/kg-day	4.00E-03	mg/kg-day	4.35E-04
				Carbon Tetrachloride	4.90E-01	µg/L	4.73E-07	mg/kg-day	7.00E-02	$(mg/kg-day)^{-1}$	3.31E-08	3.68E-06	mg/kg-day	4.00E-03	mg/kg-day	9.19E-04
				Chloroform	1.00E+00	µg/L	9.64E-07	mg/kg-day	3.10E-02	$(mg/kg-day)^{-1}$	2.99E-08	7.50E-06	mg/kg-day	1.00E-02	mg/kg-day	7.50E-04
				cis-1,2-Dichloroethene	6.48E+00	µg/L	6.25E-06	mg/kg-day	NA	NA	NA	4.86E-05	mg/kg-day	2.00E-03	mg/kg-day	2.43E-02
				Ethylbenzene	2.80E+00	µg/L	2.70E-06	mg/kg-day	1.10E-02	$(mg/kg-day)^{-1}$	2.97E-08	2.10E-05	mg/kg-day	1.00E-01	mg/kg-day	2.10E-04
				Methyl Tert-Butyl Ether	1.05E+01	µg/L	1.02E-05	mg/kg-day	1.80E-03	$(mg/kg-day)^{-1}$	1.83E-08	7.91E-05	mg/kg-day	NA	NA	NA
				Tetrachloroethene	4.07E+02	µg/L	3.92E-04	mg/kg-day	2.10E-03	$(mg/kg-day)^{-1}$	8.24E-07	3.05E-03	mg/kg-day	6.00E-03	mg/kg-day	5.09E-01
				Trichloroethene	1.25E+02	µg/L	1.21E-04	NA	4.60E-02	$(mg/kg-day)^{-1}$	2.60E-05	9.38E-04	mg/kg-day	5.00E-04	mg/kg-day	1.88E+00
				Vinyl Chloride	9.10E+00	µg/L	8.78E-06	mg/kg-day	7.20E-01	$(mg/kg-day)^{-1}$	6.32E-06	6.83E-05	mg/kg-day	3.00E-03	mg/kg-day	2.28E-02
				Inorganics												
				Arsenic	3.10E+00	µg/L	2.99E-06	mg/kg-day	1.50E+00	$(mg/kg-day)^{-1}$	4.48E-06	2.33E-05	mg/kg-day	3.00E-04	mg/kg-day	7.75E-02
				Chromium	8.90E+00	µg/L	8.58E-06	mg/kg-day	5.00E-01	$(mg/kg-day)^{-1}$	4.29E-06	6.68E-05	mg/kg-day	3.00E-03	mg/kg-day	2.23E-02
				Cobalt	6.90E+00	µg/L	6.65E-06	mg/kg-day	NA	NA	NA	5.18E-05	mg/kg-day	3.00E-04	mg/kg-day	1.73E-01
				Vanadium	9.10E+00	µg/L	8.78E-06	mg/kg-day	NA	NA	NA	6.83E-05	mg/kg-day	9.00E-03	mg/kg-day	7.58E-03
				Zinc	9.50E+02	µg/L	9.16E-04	mg/kg-day	NA	NA	NA	7.13E-03	mg/kg-day	3.00E-01	mg/kg-day	2.38E-02
			Exp. Route Total								4.21E-05					2.74E+00
		Exposure Point Total									4.21E-05					2.74E+00

NA = not applicable

RfD = reference dose

RfC = reference concentration

µg/L = microgram per liter

mg/kg-day = milligram per kilogram per day

TABLE F-2.1

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR CHEMICALS OF POTENTIAL CONCERN

CENTRAL TENDENCY EXPOSURE

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Scenario Timeframe:	Future
Receptor Population:	Resident
Receptor Age:	Lifetime[1]

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient				
				Ingestion	Dermal Contact	Inhalation	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Dermal Contact	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Groundwater	**Volatile Organic Compounds**									
			1,1-Dichloroethane	2E-07	2E-08	1E-07	3E-07	Kidney	1.47E-03	1.68E-04	NA	1.64E-03
			1,1-Dichloroethene	NA	NA	NA	NA	Liver	7.26E-03	1.46E-03	3.58E-03	1.23E-02
			Benzene	3E-08	8E-09	1E-08	5E-08	Blood	1.45E-03	3.23E-04	3.64E-04	2.13E-03
			Carbon Tetrachloride	9E-08	4E-08	2E-08	1E-07	Liver/Kidney	3.05E-03	1.19E-03	2.23E-04	4.47E-03
			Chloroform	8E-08	1E-08	1E-07	2E-07	Liver/Alimentary System/ Kidney/Development	2.49E-03	3.31E-04	1.63E-04	2.99E-03
			cis-1,2-Dichloroethene	NA	NA	NA	NA	Kidney	8.08E-02	NA	NA	8.08E-02
			Ethylbenzene	8E-08	8E-08	3E-08	2E-07	Liver/Kidney	6.98E-04	6.12E-04	1.15E-04	1.43E-03
			Methyl Tert-Butyl Ether	5E-08	NA	1E-08	6E-08	Liver/Kidney	NA	NA	1.46E-04	1.46E-04
			Tetrachloroethene	2E-06	2E-06	6E-07	5E-06	Nervous System/Liver/ Kidney/CNS	1.69E+00	1.47E+00	4.52E-01	3.61E+00
			Trichloroethene	3E-05	7E-06	5E-06	4E-05	Heart/ Immune System/ Development/Kidney/Liver	6.23E+00	1.57E+00	2.92E+00	1.07E+01
			Vinyl Chloride	2E-04	1E-05	1E-04	3E-04	Liver	7.56E-02	5.73E-03	4.75E-03	8.61E-02
			Inorganics									
			Arsenic	1E-05	8E-08	NA	1E-05	Development/Cardiovascular System/Nervous System/ Lung/Skin	2.58E-01	1.57E-03	NA	2.59E-01
			Chromium	1E-05	8E-08	NA	1E-05	Lung	7.40E-02	1.81E-02	NA	9.20E-02
			Cobalt	NA	NA	NA	NA	Thyroid/Respiratory System/ Lung	5.73E-01	1.40E-03	NA	5.75E-01
			Vanadium	NA	NA	NA	NA	Hair/Respiratory System	2.52E-02	5.92E-03	NA	3.11E-02
			Zinc	NA	NA	NA	NA	Development	7.89E-02	2.89E-04	NA	7.92E-02
			Chemical Total	2E-04	2E-05	1E-04	4E-04	Chemical Total	9.11E+00	3.08E+00	3.38E+00	1.56E+01
		Exposure Point Total					4E-04					1.56E+01
	Exposure Medium Total						4E-04					1.56E+01
Medium Total							4E-04					1.56E+01
Receptor Total							4E-04					1.56E+01

Total Excess Cancer Risk Across All Media	4E-04
Total Hazard Index (HI) Across All Media	16
Alimentary System HI Across All Media =	<0.01
Blood HI Across All Media =	<0.01
Cardiovascular System HI Across All Media =	0.3
CNS HI Across All Media =	4
Development HI Across All Media =	11
Hair HI Across All Media =	0.03
Heart HI Across All Media =	11
Immune system HI Across All Media =	11
Kidney HI Across All Media =	14
Liver HI Across All Media =	14
Lung HI Across All Media =	0.9
Nervous System HI Across All Media =	4
Respiratory System HI Across All Media =	0.6
Skin HI Across All Media =	0.3
Thyroid HI Across All Media =	0.6

NA = not applicable

CNS = central nervous system

[1] cancer risk is based on age-adjusted scenario and noncancer hazard index is based on child exposure scenario

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TABLE F-2.2

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR CHEMICALS OF POTENTIAL CONCERN

CENTRAL TENDENCY EXPOSURE

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Scenario Timeframe:	Future
Receptor Population:	Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient				
				Ingestion	Dermal Contact	Inhalation	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Dermal Contact	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Groundwater	**Volatile Organic Compounds**									
			1,1-Dichloroethane	6E-08	NA	NA	6E-08	Kidney	4.43E-04	NA	NA	4.43E-04
			1,1-Dichloroethene	NA	NA	NA	NA	Liver	2.18E-03	NA	NA	2.18E-03
			Benzene	1E-08	NA	NA	1E-08	Blood	4.35E-04	NA	NA	4.35E-04
			Carbon Tetrachloride	3E-08	NA	NA	3E-08	Liver/Kidney	9.19E-04	NA	NA	9.19E-04
			Chloroform	3E-08	NA	NA	3E-08	Liver/Alimentary System/ Kidney/Development	7.50E-04	NA	NA	7.50E-04
			cis-1,2-Dichloroethene	NA	NA	NA	NA	Kidney	2.43E-02	NA	NA	2.43E-02
			Ethylbenzene	3E-08	NA	NA	3E-08	Liver/Kidney	2.10E-04	NA	NA	2.10E-04
			Methyl Tert-Butyl Ether	2E-08	NA	NA	2E-08	Liver/Kidney	NA	NA	NA	NA
			Tetrachloroethene	8E-07	NA	NA	8E-07	Nervous System/Liver/ Kidney/CNS	5.09E-01	NA	NA	5.09E-01
			Trichloroethene	3E-05	NA	NA	3E-05	Heart/ Immune System/ Development/Kidney/Liver	1.88E+00	NA	NA	1.88E+00
			Vinyl Chloride	6E-06	NA	NA	6E-06	Liver	2.28E-02	NA	NA	2.28E-02
			Inorganics									
			Arsenic	4E-06	NA	NA	4E-06	Development/Cardiovascular System/Nervous System/ Lung/Skin	7.75E-02	NA	NA	7.75E-02
			Chromium	4E-06	NA	NA	4E-06	Lung	2.23E-02	NA	NA	2.23E-02
			Cobalt	NA	NA	NA	NA	Thyroid/Respiratory System/ Lung	1.73E-01	NA	NA	1.73E-01
			Vanadium	NA	NA	NA	NA	Hair/Respiratory System	7.58E-03	NA	NA	7.58E-03
			Zinc	NA	NA	NA	NA	Development	2.38E-02	NA	NA	2.38E-02
			Chemical Total	4E-05	--	--	4E-05	Chemical Total	2.74E+00	--	--	2.74E+00
		Exposure Point Total					4E-05					2.74E+00
	Exposure Medium Total						4E-05					2.74E+00
Medium Total							4E-05					2.74E+00
Receptor Total							4E-05					2.74E+00

Total Excess Cancer Risk Across All Media	4E-05
Total Hazard Index (HI) Across All Media	3
Alimentary System HI Across All Media =	<0.01
Blood HI Across All Media =	<0.01
Cardiovascular System HI Across All Media =	0.08
CNS HI Across All Media =	0.5
Development HI Across All Media =	2
Hair HI Across All Media =	<0.01
Heart HI Across All Media =	2
Immune system HI Across All Media =	2
Kidney HI Across All Media =	2
Liver HI Across All Media =	2
Lung HI Across All Media =	0.3
Nervous System HI Across All Media =	0.6
Respiratory System HI Across All Media =	0.2
Skin HI Across All Media =	0.08
Thyroid HI Across All Media =	0.2

NA = not applicable

CNS = central nervous system

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TABLE F-3.1

RISK ASSESSMENT SUMMARY

CENTRAL TENDENCY EXPOSURE

Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2

Garden City, New York

Scenario Timeframe:	Future
Receptor Population:	Resident
Receptor Age:	Lifetime[1,1]

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient				
				Ingestion	Dermal Contact	Inhalation	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Dermal Contact	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Groundwater	**Volatile Organic Compounds**									
			Tetrachloroethene	2E-06	2E-06	6E-07	5E-06	Nervous System/Liver/ Kidney/CNS	1.69E+00	1.47E+00	4.52E-01	3.61E+00
			Trichloroethene	3E-05	7E-06	5E-06	4E-05	Heart/ Immune System/ Development/Kidney/Liver	6.23E+00	1.57E+00	2.92E+00	1.07E+01
			Vinyl Chloride	2E-04	1E-05	1E-04	3E-04	Liver	7.56E-02	5.73E-03	4.75E-03	8.61E-02
			Inorganics									
			Arsenic	1E-05	8E-08	NA	1E-05	Development/Cardiovascular System/Nervous System/ Lung/Skin	2.58E-01	1.57E-03	NA	2.59E-01
			Chromium	1E-05	8E-08	NA	1E-05	Lung	7.40E-02	1.81E-02	NA	9.20E-02
			Cobalt	NA	NA	NA	NA	Thyroid/Respiratory System/ Lung	5.73E-01	1.40E-03	NA	5.75E-01
			Chemical Total	2E-04	2E-05	1E-04	4E-04	Chemical Total	9.11E+00	3.08E+00	3.38E+00	1.56E+01
		Exposure Point Total					4E-04					1.56E+01
	Exposure Medium Total						4E-04					1.56E+01
Medium Total							4E-04					1.56E+01
Receptor Total							4E-04					1.56E+01

Total Excess Cancer Risk Across All Media	4E-04
Total Hazard Index (HI) Across All Media	16
CNS HI Across All Media =	4
Development HI Across All Media =	11
Heart HI Across All Media =	11
Immune system HI Across All Media =	11
Kidney HI Across All Media =	14
Liver HI Across All Media =	14
Nervous System HI Across All Media =	4

NA = not applicable

Note:

Only chemicals above EPA's threshold values are listed in this table

(1) cancer risk is based on age-adjusted scenario and noncancer hazard index is based on child exposure scenario

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TABLE F-3.2
RISK ASSESSMENT SUMMARY
CENTRAL TENDENCY EXPOSURE
Old Roosevelt Field Contaminated Groundwater Area Site, Operable Unit 2
Garden City, New York

Scenario Timeframe:	Future
Receptor Population:	Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Cancer Risk				Noncancer Hazard Quotient				
				Ingestion	Dermal Contact	Inhalation	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Dermal Contact	Inhalation	Exposure Routes Total
Groundwater	Groundwater	Groundwater	**Volatile Organic Compounds**									
			Tetrachloroethene	8E-07	NA	NA	8E-07	Nervous System/Liver/ Kidney/CNS	5.09E-01	NA	NA	5.09E-01
			Trichloroethene	3E-05	NA	NA	3E-05	Heart/ Immune System/ Development/Kidney/Liver	1.88E+00	NA	NA	1.88E+00
			Vinyl Chloride	6E-06	NA	NA	6E-06	Liver	2.28E-02	NA	NA	2.28E-02
			Inorganics									
			Arsenic	4E-06	NA	NA	4E-06	Development/Cardiovascular System/Nervous System/ Lung/Skin	7.75E-02	NA	NA	7.75E-02
			Chromium	4E-06	NA	NA	4E-06	Lung	2.23E-02	NA	NA	2.23E-02
			Cobalt	NA	NA	NA	NA	Thyroid/Respiratory System/ Lung	1.73E-01	NA	NA	1.73E-01
			Chemical Total	4E-05	--	--	4E-05	Chemical Total	2.74E+00	--	--	2.74E+00
		Exposure Point Total					4E-05					2.74E+00
	Exposure Medium Total						4E-05					2.74E+00
Medium Total							4E-05					2.74E+00
Receptor Total							4E-05					2.74E+00

Total Excess Cancer Risk Across All Media	4E-05
Total Hazard Index (HI) Across All Media	3
Development HI Across All Media =	2
Heart HI Across All Media =	2
Immune system HI Across All Media =	2
Kidney HI Across All Media =	2
Liver HI Across All Media =	2

Note:
Only chemicals above EPA's threshold values are listed in this table
NA = not applicable
CNS = central nervous system